The FOUNDRY

Volume 50
Number 3

Published
Semimonthly

CLEVELAND, OHIO, FEBRUARY 1, 1922

Complete Huge Wisconsin Foundry

Conservation of Labor and Simplicity of Equipment Characterize New Plant Built to Produce Large Tonnage of Miscellaneous Gray-Iron Castings

BELOIT, Wis., a prosperous little industrial city about 100 miles from Chicago may claim one of the largest gray-iron foundries in the world. This extensive plant, built for Fairbanks, Morse & Co., will have a capacity of 500 tons per day, of gray-iron castings varying in weight from one pound to fifteen tons. They will be utilized in the manufacture of semideisel oil, gas, internal combustion marine and farm engines; in centrifugal pumps and miscellaneous agricultural and railroad devices.

The company has been manufacturing this line of work for many years and has operated its own foundry continuously. As business increased, a constantly growing tonnage of castings were obtained by purchase from other foundries. This condition, and other vital considerations influenced the company to build a gray-iron foundry which will take care of anticipated growth in its business for at least ten years to come. As this foundry was laid out to take care of an increasing trade for some years, it cannot be filled to its capacity with the company's own work, especially under present conditions. Consequently, for some years the company will take on contract work, to enable it to operate the foundry at practically its maximum capacity.

The old foundry of Fairbanks, Morse & Co. was an evolution. As the business increased, additions were made and all of the difficulties of handling material thereby immensely multiplied. The original layout did not contemplate handling any such immense tonnage as the growth of the business required, and as a natural consequence the cost of handling the material was high.

From investigation of records the tonnage required to take care of the growth for a definite period was determined easily, and it was decided to

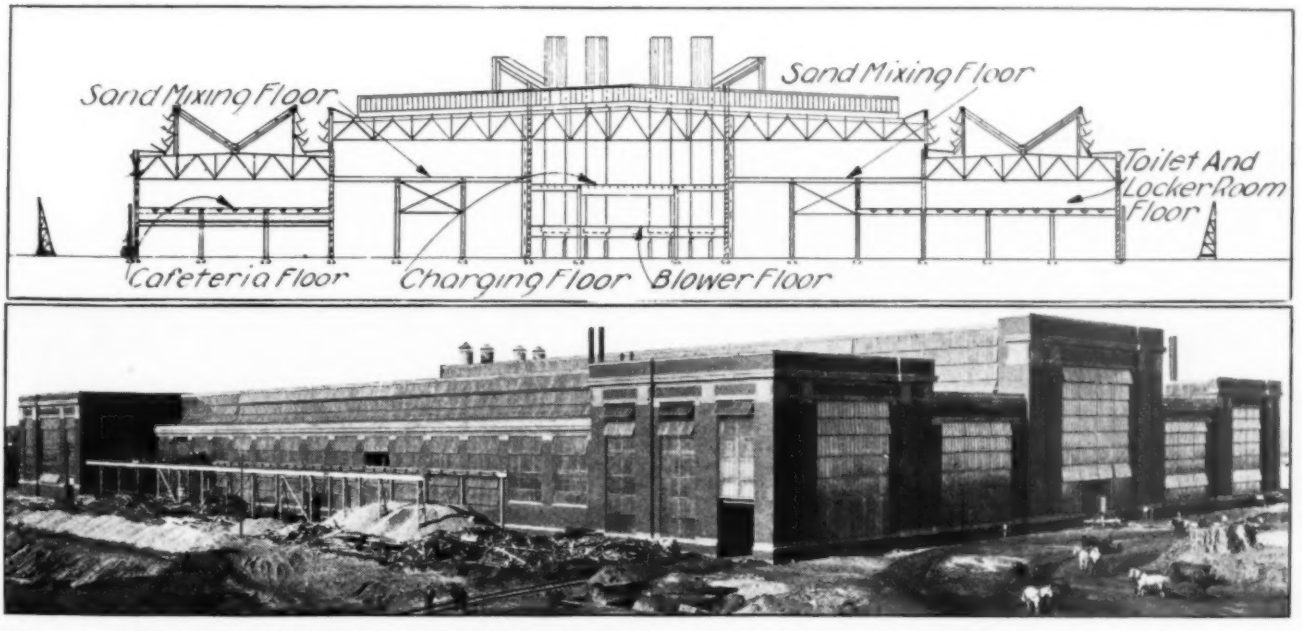


FIG. 1—A RAILWAY WAS MOVED AND LOWLANDS FILLED TO BUILD THIS IMMENSE STRUCTURE—THE CROSS SECTION ABOVE INDICATES ITS ARRANGEMENT

construct the new foundry for a daily production of 500 tons, when operating at full capacity. As soon as these basic conditions were ascertained, and the building of the foundry authorized by the company, the design, construction and equipment of the plant were placed solely under the charge of R. J. Barr, superintendent of foundries, of the Fairbanks, Morse Co., and C. A. Hardy, Chicago, foundry engineer. Whiting Foundry Equipment Co. Consequently the new foundry is an embodiment of the combined judgment and experience of the two men and represents the realization of their ideals. In this they received the hearty co-operation of the executives of the Fairbanks Co., whose sole instructions were to build a foundry which could produce castings with the lowest hours of labor per ton of output possible.

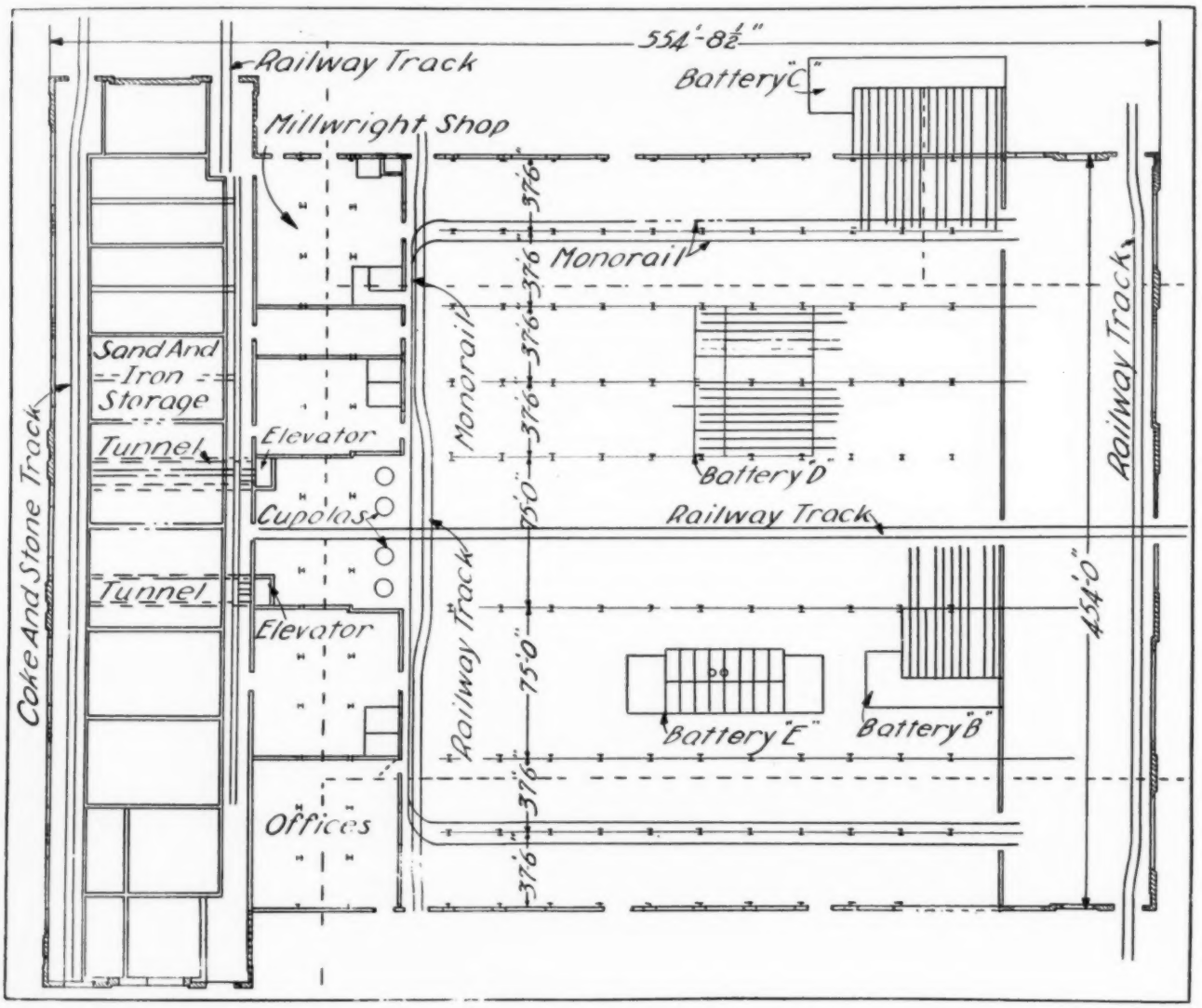


FIG. 2—ALL MATERIALS MOVE IN A STRAIGHT LINE THROUGH THE PLANT—THE SHOP IS PRACTICALLY THREE LARGE FOUNDRIES COMBINED

Comprehensive studies of methods and floor space required for the economical production of castings were prepared. Many of the large foundries in the United States were visited and methods inspected.

Mr. Barr has been a foundryman from his youth and formerly was superintendent of foundries for the Western Electric Co., Chicago, and went from there to General Electric Co. where he had charge of the design, layout and operation of their foundries at Erie, Pa. Mr. Hardy was for many years sales engineer for the

Consequently, two considerations, namely, utility and efficiency governed throughout. The arrangement, that is to say the layout of the plant, was made to conform in every detail to a straight line movement of materials and products. The equipment in every case was forced to meet the test of the two qualities first named, and thirdly the financial question "Will it earn interest, depreciation and dividends?" In every instance the question raised in connection with either layout or equipment was, "Will it save men, and if it saves men, will it save more in the wages of these men than the interest, depreciation and upkeep of the equipment?" If equipment could not stand this critical analysis, other methods were found.

The bodily comfort of the men was thoroughly recognized as a fundamental necessity to promote efficiency. Accordingly, this plant is a model in its provision for lighting, heating, ventilation, restrooms for female employes, sanitary toilets, baths, lockers, restaurants, first aid equipment and other features which have to do with the welfare of the workmen. Mr. Barr and Mr. Hardy state that the production per man, owing to the excellent lighting, comfortable and cheerful surroundings in the plant will undoubtedly be increased from ten to fifteen per cent.

An idea of the stupendous character of the undertaking may be gained from Fig. 1. The building itself is imposing, covering as it does, all the various departments of this huge

FIG. 3—THE CENTER SPACIOUS BAY IS SURMOUNTED BY A ROOF SYSTEM WHICH GIVES FREE LIGHT AND VENTILATION —HEATED AIR IS DELIVERED AT THE BASE OF THE COLUMNS AS SHOWN AT *B*

foundry under one roof, with the exception of pattern shop and pattern storage, which will be in a fireproof concrete building adjacent to the foundry.

The change in the general arrangement of the plant for economical operation required that the main belt track of the C. M. & St. P. Ry. be moved and the cut through which it passed filled. This involved the construction of about ¾ mile of new track over which all of the material coming into the plant will be handled. Owing to the location of the plant on a hill, considerable grading and backfilling was necessary, and the foundations for cupola room and material bay, which face the Rock river, located on a side hill, were carried down to a firm foundation. This necessitated more concrete work than ordinary building would require, but the location was taken advantage of to construct storage bins for core sand, molding sand and coke.

Architecturally Attractive

That architectural beauty is not incompatible with efficient design may be noted. This plant suggests the public building rather than the shop. Following the dictates of good engineering practice composite construction was adopted, with steel columns, roof trusses and frame work; this enclosed in a skeleton frame of brick, ornamented with stone, and with the main walls and much of the roof of glass. A heavy ribbed glass was used which has high insulating qualities, and still admits and directs light to a degree that closely approaches the outdoors in its amplitude of illumination.

The roof construction, as shown in Fig. 3, is worthy of particular mention. The main or central bay is sur-

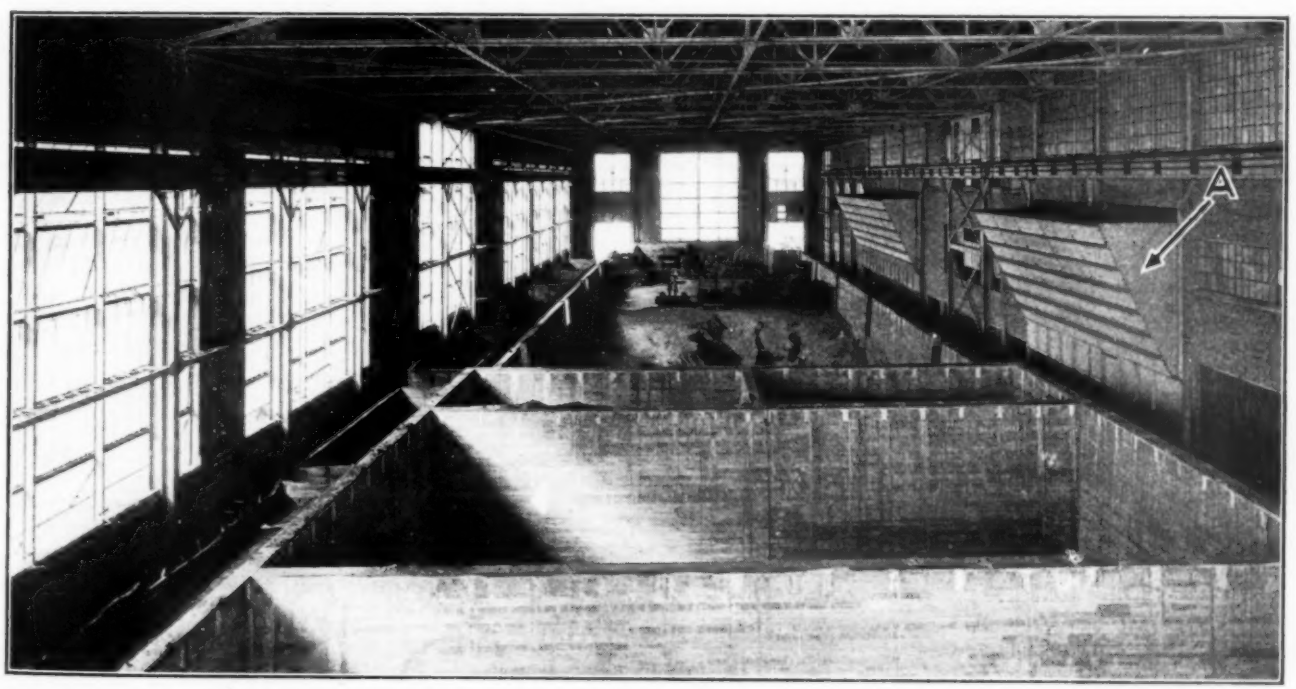


FIG. 4—SAND AND IRON ARE STORED IN SEPARATE BINS—THE FORMER IS PICKED UP AND DROPPED THROUGH THE WALL POCKETS AT THE RIGHT

mounted by a single deep-valleyed Pond truss. Each side of this truss has five lines of motor controlled sash. At the right and left are two A-frame roofs, over the corerooms and the lines of sash in these A-frames also are motor controlled. Over the molding bays at each side of the building, a smaller Pond truss is shown, also with motor controlled sash. This roof construction continues over the cleaning room. All of the sash in the building was supplied by David Lupton Sons Co., Philadelphia.

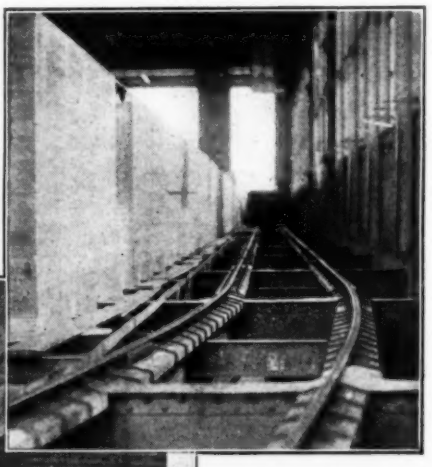
The ventilation of the building and the movement of air through it is so perfectly controlled by these various devices that during the past summer the average temperature in the building was some five or six degrees below that of other buildings and offices of the plant.

Reinforced Concrete Roof

The roof over material bay and in the valleys of the main building is made of reinforced concrete supporting hollow building tile and on top of this is laid a standard roof. As the two bays at either side of the foundry and the center bay are used for pouring, the hot air arising from these floors is taken off through the truss roofs over them, and the A-frames between the Pond trusses which are over the core rooms and which light them, act as intakes. With this arrangement of roof and sash the dust is readily kept out of the cleaning room, and sufficient light so that workmen can chip, grind and inspect castings is provided. In the cleaning room the space in the roof trusses is used by the dust arresters, fans and other exhaust equipment.

The general arrangement of the plant is similar in some of its features to many other foundries, but many unique departures from established practice are incorporated. The material bay, which is shown on the plan, Fig. 2, and which is shown in detail in Fig. 4 extends across the entire west end of the structure. Sufficient capacity is provided to store between 3000 and 4000 tons of coke, 20,000 tons of sand and 25,000 tons of pig iron and scrap, in addition to limestone, facings and other miscellaneous supplies required in a plant of this character. This storage feature, so vital to an establishment which must be independent of the exigencies of freight haul, weather and other outward factors, has been cared for in a big way. Separate bins, constructed of reinforced concrete, extend down over 40 feet from the grade line. There are a sufficient number of bins so that all of the different kinds of sand required are stored separately. It is estimated that these bins will contain a sufficient supply to carry the foundry five to six months when operating at full capacity. As shown in Fig. 4 the material bay is entirely closed in and roofed over so that all materials are protected from the weather, and men working in the yard are not exposed.

Standard practice in practically all large foundries requires a crane over the material yard, and this crane generally is equipped to handle a bucket and magnet so it can be used for unloading sand, pig iron and scrap. Wherever this is done, this matter of enclosing it and putting on a roof is not exceedingly expensive, as the columns for carrying the crane runway need only to be strengthened a little to carry the roof trusses and roof so that practically all the additional expense incurred is for roof trusses, roof and side walls. When this is taken into consideration, the saving in labor in clearing the material yard of snow, increased wage cost during the extreme cold weather and hot weather in collecting materials, and the casting loss increased from using frozen sand, pays a handsome interest on the investment required to cover this yard.



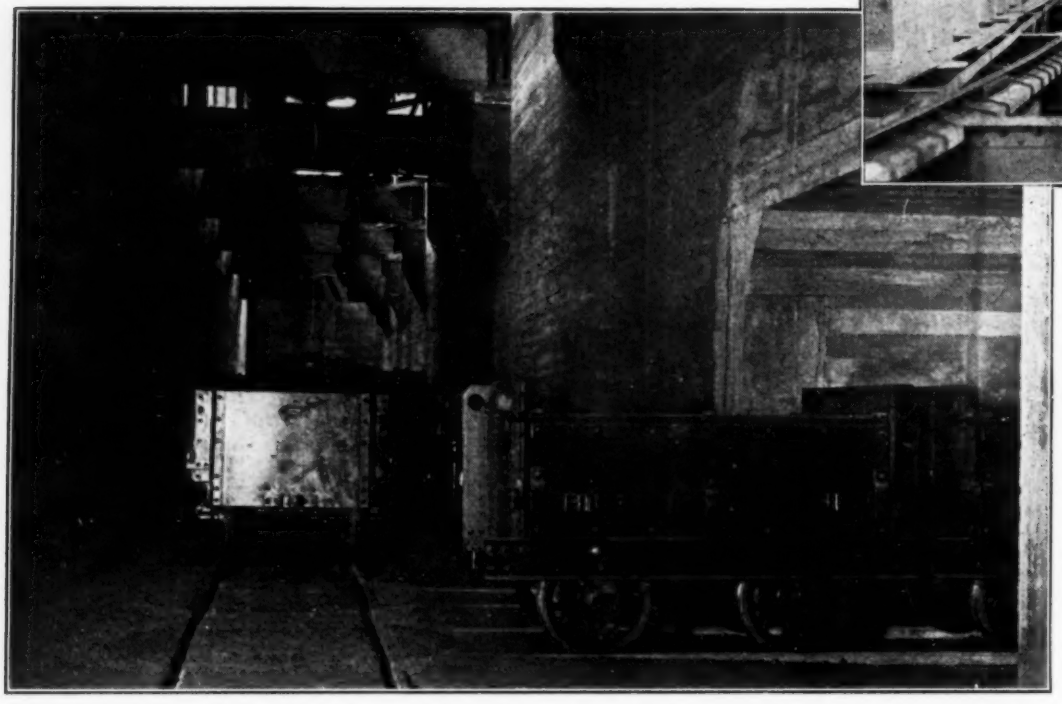


FIG. 5—AT THE LEFT — COKE CARS ARE LOADED, WEIGHED, SHUNTED TO A TURNTABLE AND SHOVED INTO THE TUNNEL LEADING TO THE ELEVATORS FIG. 6—ABOVE—INCOMING COKE AND STONE CARS ARE UNLOADED DIRECTLY INTO THE PIT

Material Track at North End

The pig iron storage is on grade level and is divided into compartments, each compartment equipped with a track and charging scale. Back of these bins is the material track which enters at the north end of the building. Between these bins and the cupola bay is a track for an electric transfer car. At the north end, a spur from the yard tracks enters the building to allow core oil, sea coal and other supplies to be unloaded inside the building. Furthermore, as

the crane can reach this track, any heavy piece of machinery, molding machines and other equipment can be received and unloaded by the crane.

Two elevators constructed by Reliance Elevator Co., Chicago, serve the cupola charging floor. These elevators are of the push-button type with a special device for leveling. Each elevator has capacity of about ten tons and has two tracks laid on the floor so that two charging cars can go up at the same time. The operating speed is 75 feet per minute.

The main material track which enters the building on the west side of the sand and pig iron bins, is supported on steel beams set into the outer wall and the walls of the bins. Underneath this track and extending its entire length is a pit about 20 feet deep and approximately 13 feet wide, with concrete floor carrying a track the full length of the building. Leading from this pit to each elevator is a double-tracked tunnel which runs under the level of the pig iron storage. The pit, as shown in Figs. 5 and 6, constitutes the storage space for coke and limestone, which are brought in on material track, unloaded and dropped through the track beams into the storage space below. Coke scales are located at the entrance to each tunnel so that coke may be loaded and weighed directly into the coke cars, pushed over onto elevator and delivered onto charging floor. By this method, the coke is handled from freight car into the storage pile and is not further handled until it is forked into the coke cars. From these cars it is dumped by machinery into the cupola. Of course, if coke is delivered in bottom dump cars, it is unloaded directly, otherwise it is forked out over side or through the door. The double track through the tunnels permits two cars to be loaded onto the elevator at once whenever this is found necessary.

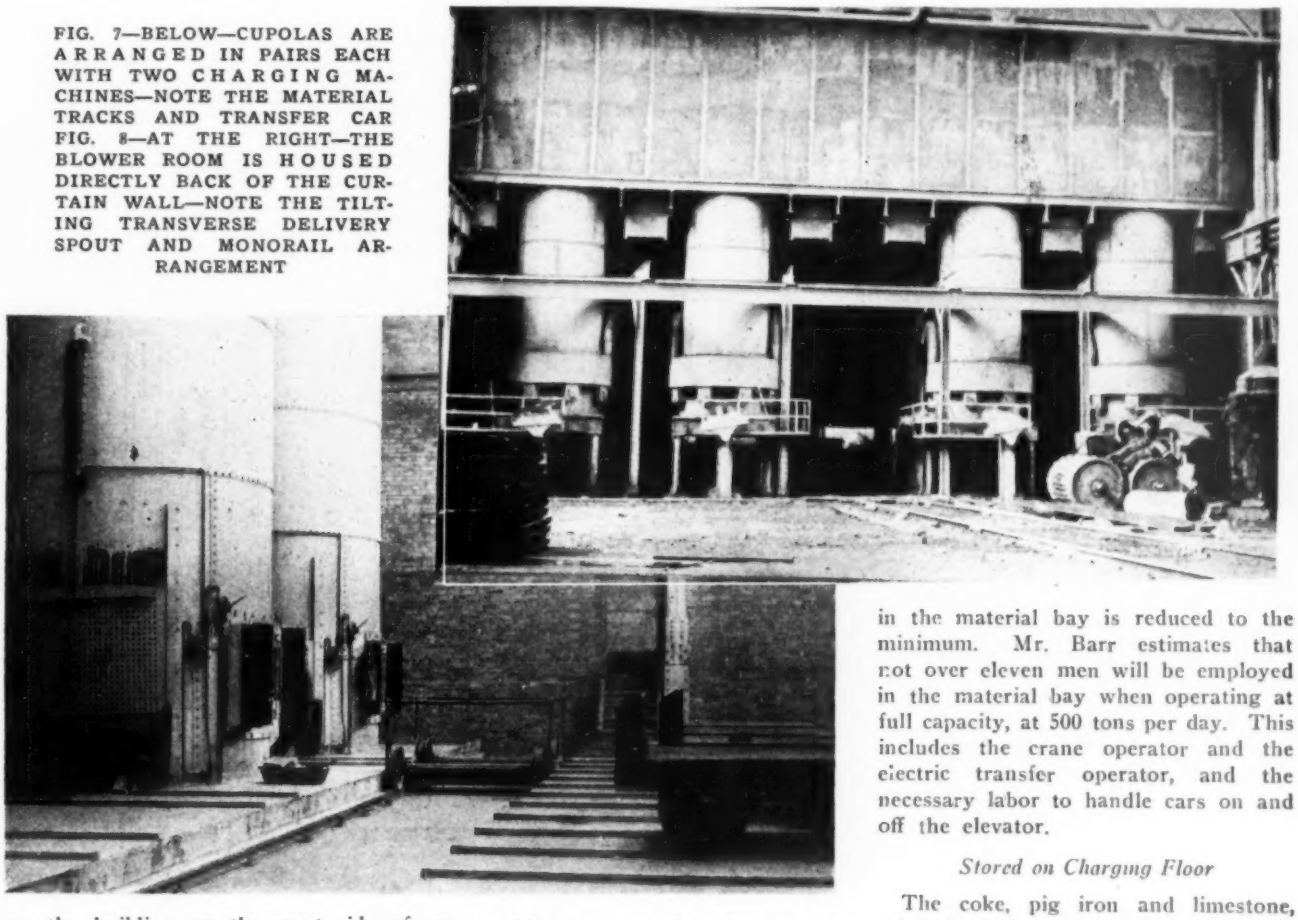


FIG. 7—BELOW—CUPOLAS ARE ARRANGED IN PAIRS EACH WITH TWO CHARGING MACHINES—NOTE THE MATERIAL TRACKS AND TRANSFER CAR FIG. 8—AT THE RIGHT—THE BLOWER ROOM IS HOUSED DIRECTLY BACK OF THE CURTAIN WALL—NOTE THE TILTING TRANSVERSE DELIVERY SPOUT AND MONORAIL ARRANGEMENT

In making up cupola charges, the pig iron and scrap are loaded upon charging cars. As the charge for each cupola approximates about 3600 pounds after the bed charge, the cars have a capacity of about 1800 to 2000 pounds each. They are loaded on tracks extending into each of the several iron bins and on each of these tracks is a charging scale. After loading, which is assisted by the magnet on the crane, the cars are pushed out onto the electric transfer, holding two charging cars. The transfer car is moved along to one of the elevators and the charging cars shoved upon it. The transfer car which was built by the Whiting Corp., Harvey, Ill. operates over the full length of the foundry in front of all the material bins.

Sand is unloaded from gondola cars into storage bins by a grab bucket on the material bay crane. This crane is of 20 ton capacity, the grab bucket has a lifting speed of 120 feet per minute and also is equipped to handle a magnet. The magnet is used for unloading pig iron and scrap and also in breaking up return scrap from the foundry. When handling the sand, the grab bucket picks it out of the storage bins and drops it into hoppers, communicating with the sand bins on the sand mixing floor, as shown in Fig. 4. By these methods the labor employed in the material bay is reduced to the minimum. Mr. Barr estimates that not over eleven men will be employed in the material bay when operating at full capacity, at 500 tons per day. This includes the crane operator and the electric transfer operator, and the necessary labor to handle cars on and off the elevator.

Stored on Charging Floor

The coke, pig iron and limestone, when loaded on cars and delivered by elevators to the cupola room, are placed on storage tracks on the charging room floor, which is 27 feet above the grade level, as shown in the cross section Fig. 1. A hand transfer track extends in front of the cupolas as shown in Fig. 7. The cupolas are equipped with Whiting charging machines and half of the charge is delivered on each side of the cupola and charged in at the same time, giving a uniform distribution over the bed. In this particular plant Mr. Hardy found it necessary to use a duplex charging machine, which may be made to charge at will into either of the two cupolas located at the side of it. This was because the pairs of cupolas were set too closely to admit two ma-

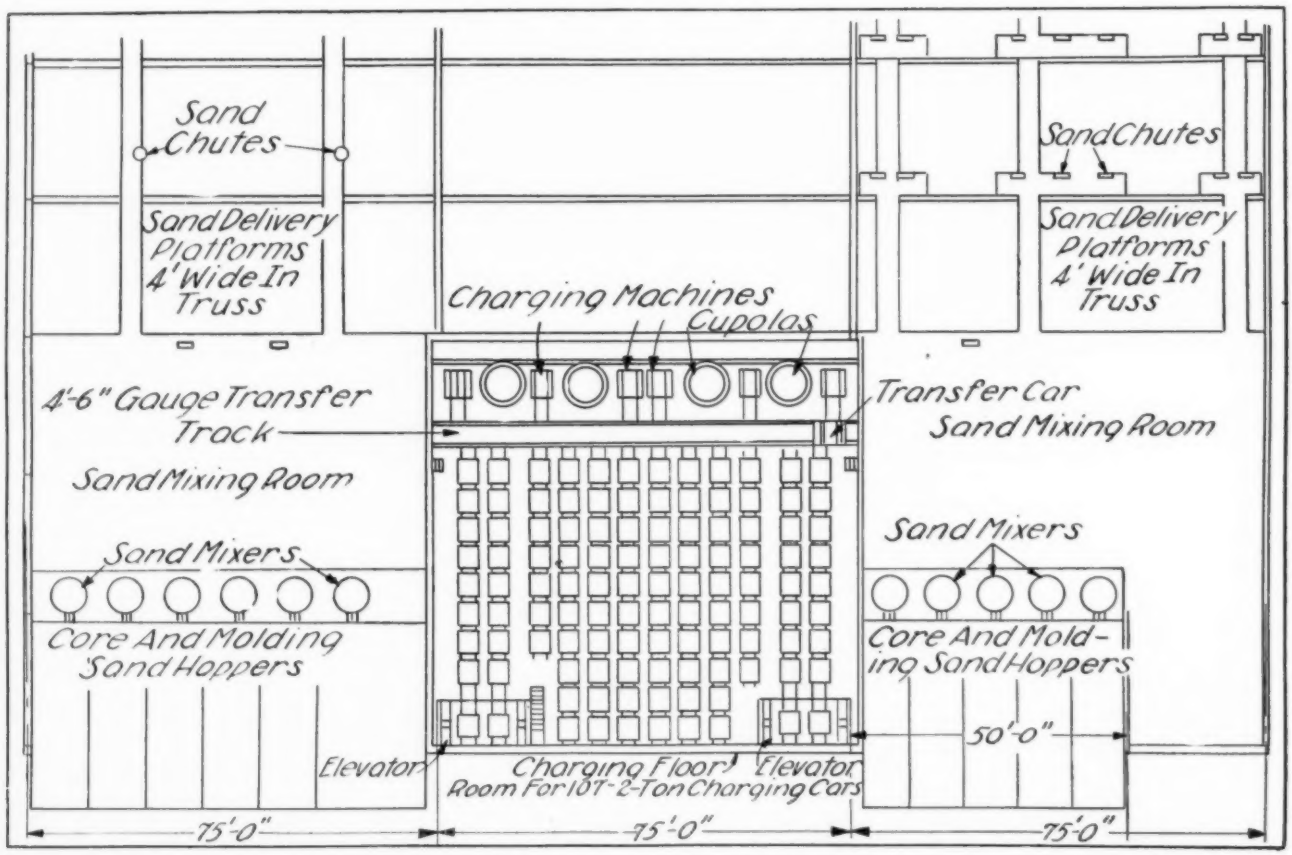


FIG. 9—THE CUPOLA CHARGING FLOOR IS FLANKED AT A SLIGHTLY HIGHER LEVEL BY THE TWO SAND-MIXING ROOMS

chines. This particular type of two-way charging machine had not been installed previously, but was anticipated and designed by Mr. Hardy several years ago. The labor on the charging floor is reduced to two men, whereas on the two charging floors in the old foundry, a total of about 26 men were employed.

The charging floor is of ample size and loaded cars in sufficient number to insure the operation of the plant for several hours can be stored for use in case of accident to elevators or other equipment. The cupola doors are handled by air cylinders thereby rendering their operation almost automatic. For convenience in relining, inspection and repairing cupolas, an additional set of doors as shown in Fig. 7 is provided, and in case the charging machine should get out of service, it would not be necessary to drop the bottom, as by calling in additional labor the cupola may be charged by hand until the charging machines are in service again.

Continuous pouring, which is the

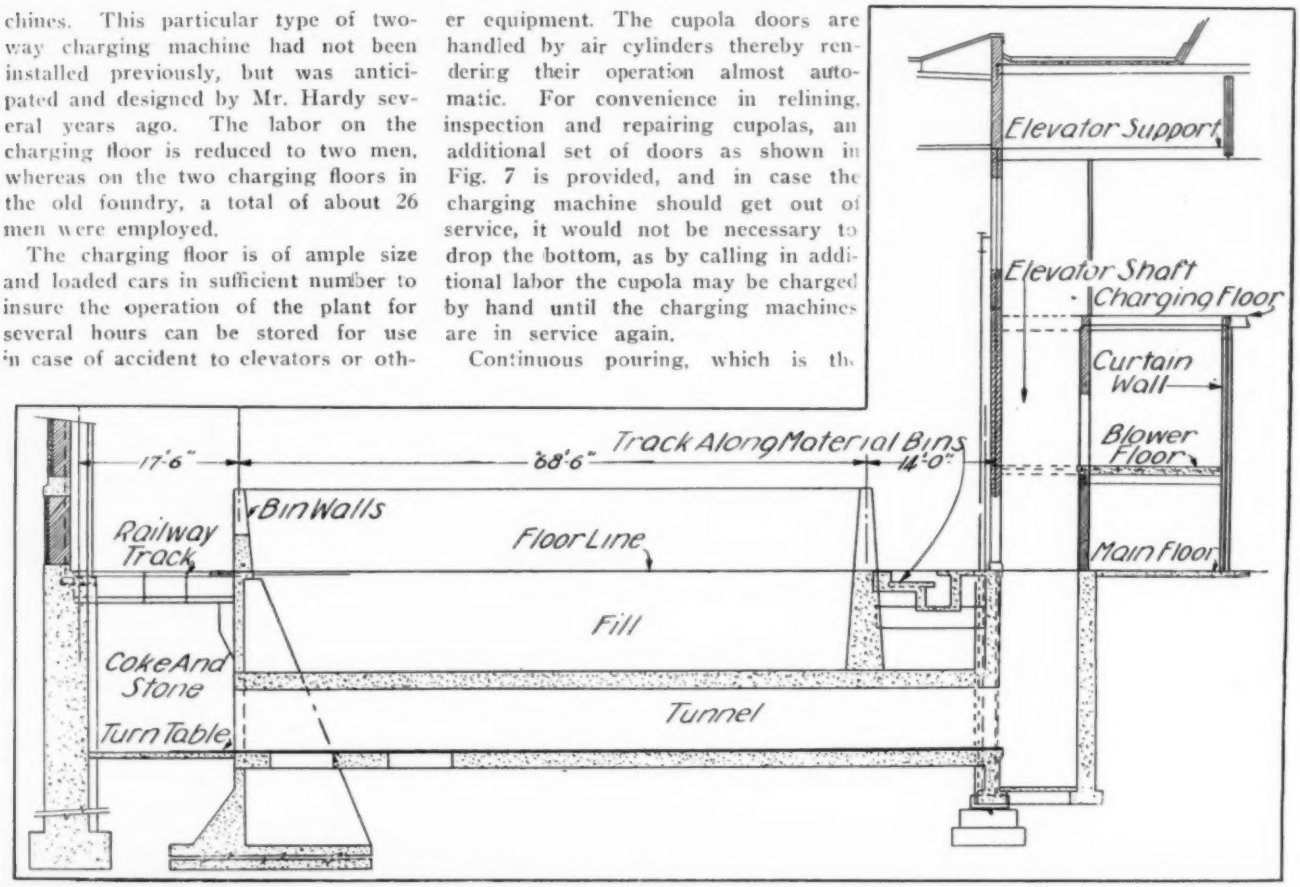


FIG. 10—SPACE WAS CONSERVED AND RAPIDITY OF DELIVERY ACHIEVED THROUGH STORING COKE BELOW THE GROUND LEVEL AND FORWARDING IT TO THE ELEVATORS THROUGH TWIN TUNNELS

method used in the old foundry for several years will be followed in the new plant. Four 96-inch special Whiting cupolas, lined down to 72 inches will provide the melting capacity and reserve for the maximum output. Two of these cupolas will be operated each day. The cupolas are the hanging-tuyere, blast-furnace type, commonly used in bessemer practice; but certain features originated by Mr. Hardy are incorporated. Each tuyere box has a separate damper which can be shut off in event that any tuyere shows black at any time when the cupolas is in operation. Each tuyere has two drop doors or hand holes which permit it to be cleaned separately if need arises. They are equipped with a special designed tuyere and lined with a bosh which is carried up to the melting zone. This method has been thoroughly tested and in continuous operation is said to prevent bridging and clogging. The two inside cupolas have two tapping spouts, one set reaching out into the foundry and one set reaching out over the track which

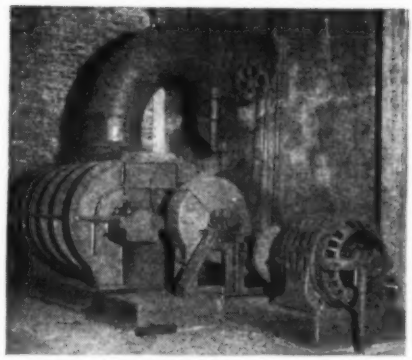


FIG. 11—ONE OF THE THREE CUPOLA BLOWERS—NOTE THE GATE VALVE COMMUNICATING TO THE MAIN

system is indicated in Fig. 2. Four trolleys manufactured by Shephard Electric Crane & Hoist Co., Montour Falls, N. Y. operate on this monorail system. Two especially designed safety switches are installed in this system as shown.

The blast for the cupolas is furnished by two motor driven positive pressure blowers made by the P. H. & F. M. Roots Co., Connersville, Ind. These operate at a speed of 175 revolutions per minute. Both blowers will be in service each day as the piping layout enables the blast from any blower to be delivered to any cupola. As a spare a blower has been installed, which is connected to the pipe line in the same manner. An ingenious arrangement of Sturtevant blast gates combined with counter weights, hand wheels and chain makes it easy for one person to operate all of the valves. When fully closed this chain is locked to a hook set into the concrete floor of the blower room which prevents the possibility of any accident. This system is shown in Fig. 11. The blower room is separated from the main foundry by curtain wall and is lighted and ventilated by windows communicating with the material bay. A sufficient amount of radiation has been installed so that in extreme temperatures the oil in the blowers will be kept sufficiently liquid to enable them to operate properly.

The drop from the cupola is handled by two large cast iron, stave type cinder mills, located directly behind each pair of cupolas. The remainder of the available space back of the cupola is used for the storage of brick, dobbing, clay wash, ladle lining and other miscellaneous cupola supplies.

The ingenious use of simple mechanical aids marks the two sand preparation rooms which are located as shown in Fig. 9. As was noted previously, sand is taken from dead storage or directly from cars by a grab bucket operating on an overhead crane in the material bay. This sand is deposited in the hoppers shown at A, Fig. 4, leading to the live storage bins indicated in the illustration. The bins provide for the storage of seven different kinds of sand. They are equipped with heater coils laid along the floor of the bin to thaw and dry the sand should need arise. Each room has a maximum capacity of approximately 200 tons of prepared sand per day.

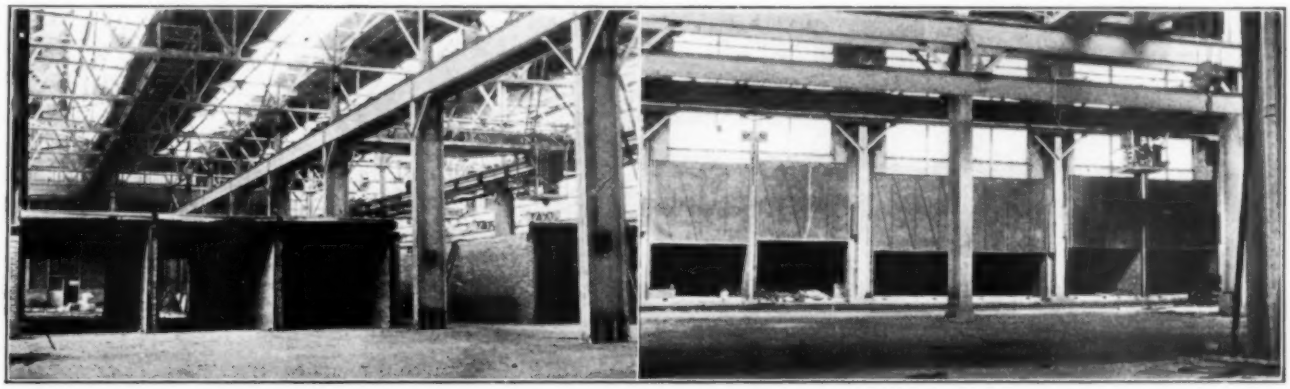


FIG. 12—THE OVER-NIGHT OVENS DURING CONSTRUCTION—NOTE THE SAND DELIVERY PLATFORM ABOVE—FIG. 13—OVENS IN BATTERY C EXTEND OUTSIDE THE FOUNDRY WALLS

extends through the center of the main bay. This arrangement is provided so that in case a heavy casting is to be poured, large ladles on cars can be filled and pulled out into the heavy molding bay by the electric locomotive.

The cupolas are designed to run continuously. They are tapped into long spouts with transverse runners at the end as shown in Fig. 8. Slag is skimmed through a skimmer slot in the side of the tapping spout. Each of the end spouts or runners is operated by lever from the cupola platform. This permits the operator to fill a ladle and immediately divert the flow to another ladle on the other side, without spilling.

A single monorail track extending along the front of the cupolas permits small cage-operated hoists to collect metal from the cupolas and distribute it to the four outside bays in the foundry. The layout of this monorail

The procedure followed in mixing sand is simple. The operator in charge of the mixing room indicates the amount of bank sand, lake sand and old sand which he needs to comply with any specific mixture. This is taken from the bins, the floor level of which is lower than the mixing floor. The operator at the bins dumps the required sand into skip hoists, one of which serves each of the muller type mixers, made by the National Engineering Co., Chicago. When the charge has been made up, the hoist is set in operation, raising and dumping the charge automatically into the mixers where the proper amount of oil, water and binder is added. The mixers are set, in each instance, on an elevated platform above the floor of the mixing room so that a dump car or wheelbarrow may be placed beneath to receive the charge when mixed. Oil and water are led directly to each mixer and measured

carefully before being added to the sand.

When a charge has been sufficiently mixed, it is dumped into wheelbarrows or dump cars on the floor of the mixing room. A laborer then wheels it out to that portion of the coreroom requiring the quality of mixture just completed. No mechanical or belt conveyor was installed as so many mixtures are required that it was felt that some method of delivering the sand individually should be installed. For this reason, sidewalks are provided running out along and supported on the lower members of the roof trusses. The workmen wheel sand out along these sidewalks and dump it over the side into chutes leading directly to the coremakers benches, boxes or to the floor heap as desired.

Under the system followed all of the rail system runs down on each side of the columns dividing the two bays used for medium work and the two bays used for light work. The distribution of iron for heavy work will be by overhead cranes, whereas in the four bays used for medium and light work all iron will be distributed over the monorail system.

Dry-Sand Molds Used

A large portion of the work in the medium molding bays will be dry sand work and for properly drying these molds a battery of six ovens designed by Mr. Hardy has been built. A certain amount of dry sand work will also be required in the heavy molding bay and another battery of three ovens opening into that bay has been installed, as shown in Fig. 2. In the

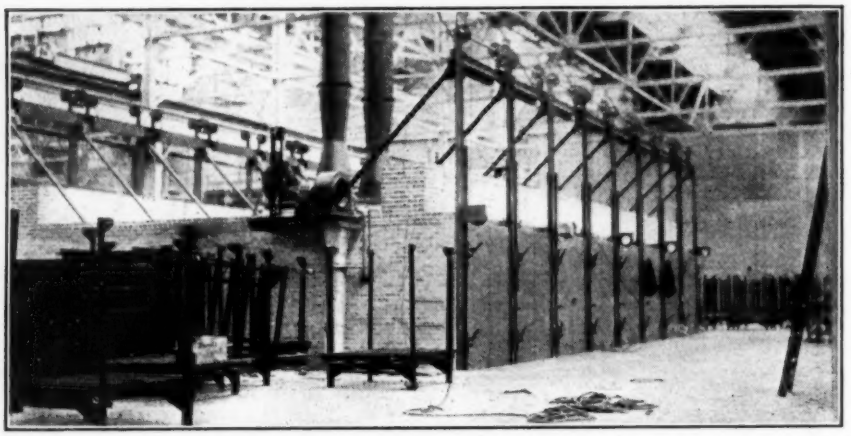


FIG. 14—THE OVENS IN BATTERY E ARE CONNECTED TO SEPARATE CHIMNEYS —NOTE THE RECORDING THERMOMETERS INSTALLED

mixers may be in continuous operation and yet an innumerable variety in the mixture and character of sand may be obtained, each particular batch being carried directly where it is needed. Mr. Hardy estimates that the labor saved in handling sand in this manner amounts to 10 or 15 men.

The main foundry is open from end to end and from side to side within the outer walls, and the necessary columns which support the roof and crane tracks serve merely to designate the imaginary line between the various departments. Of these, the two bays at the north will be assigned to medium molding machine and light floor work. These bays are 37½ feet wide. The next two bays which also are 37½ feet wide, will be used for medium and heavy core work. The center 75-foot bay of the building will be devoted to heavy molding. The next bay also is 75 feet wide and will be used for the production of light cores. Adjoining the light core room are two bays of 37½ feet, in which will be located the light molding machine floors. As shown in Fig. 2, the monoheavy core bay cores are baked in a battery of five double-end ovens, designed by Mr. Hardy, the method of operation being to fill the ovens during the day, bake at night and in the morning to push the core cars out into the storage space, inspect the cores and store them for distribution wherever needed. The cars then will be picked up by overhead cranes and carried back to the molders' benches, and when filled, picked up again by the cranes and set in front of oven, and pushed in for baking at night.

Ore Ovens Standard Type

The 16 ovens in the light core room are of standard type, designed and erected by Holcroft & Co., Detroit, Mich., which company also erected all of the other ovens. These ovens are shown in Fig. 14. In common with all the other ovens, they are provided with recording thermometers made by the Brown Instrument Co., Philadelphia.

The question of economy in baking the large amount of cores required, led to a close study of the various methods employed. The high cost of fuel oil and the prohibitive cost of gas, excluded these two methods. Certain investigations led to the adoption of the overfeed stoker, using bituminous coal, crushed to proper size for distribution in a stoker of this type. Consequently all of the core and mold drying ovens are equipped with overfeed stokers, made by the Automatic Furnace Co., Dayton, O. These are located in pits at the end of the ovens and coal is supplied through gratings directly over hoppers leading to stokers, as shown in Fig. 15. Consequently it is possible, as soon as the operation of the ovens becomes thoroughly standardized, to place a predetermined amount of fuel in hoppers, regulate the stoker to a certain rate of feed and allow the fire to die out when the fuel is exhausted.

A unique system of induced draft was installed by Mr. Hardy in the ovens shown as Battery C, Fig. 2. This is furnished by a fan, manufactured by the B. F. Sturtevant Co., Boston, directly connected to a Fairbanks-Morse motor. As shown in Fig. 16, the fan is arranged with suitable dampers so that at various stages of baking the cores or drying molds, the air may be drawn from top of furnace or from the bottom, as desired. In practical use when the fire is started and a large amount of steam and smoke is coming from the cores, the dampers are so arranged that air is taken from the top of oven. When this steam and smoke have lessened, the dampers are changed so that the air is exhausted from bottom of the ovens. After a certain period the induced draft is entirely taken off and the cores allowed to bake by the aid of natural draft only.

Compressed air and water lines in the main foundry are carried through columns below the crane runways. *T* connections permit service lines to be brought down directly where desired at each column. A complete lighting system with high power lamps, hung from roof trusses has been installed. These are controlled from boxes on the columns, which may be noted by Fig. 3. The lighting fixtures are readily accessible and may be replaced, repaired or cleaned by a workman carried along on the cranes.

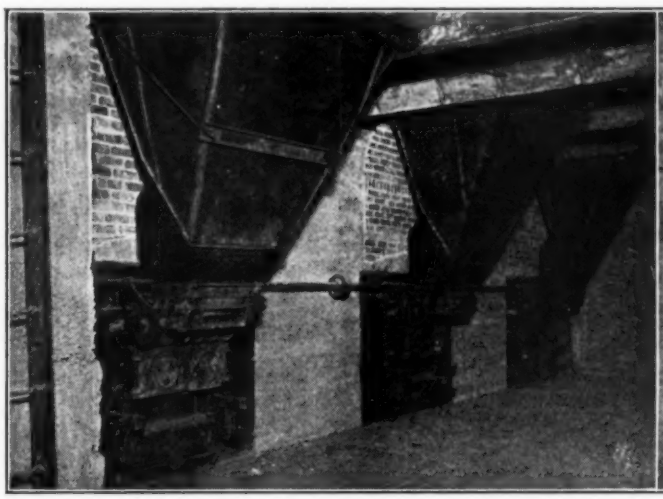
The heating system is adequate. Fresh air is brought through intakes, well outside and on opposite sides of the building. It is drawn through steam-heated coils and forced by fans into main ducts which communicate with cross channels which are beneath four of the six lines of columns. Integral with the columns in the lines indicated are outlets, set into the channels as noted at *B*, Fig. 3. The

two fans provided have a capacity of 100,000 cubic feet per minute and were furnished by the Buffalo Forge Co., Buffalo. The heating system is available as an aid to ventilation or for cooling the foundry in summer. However, during the unusually hot summer of 1921, it was found that with the natural ventilation supplied through the roof, the temperature within the foundry was several degrees lower than that recorded outside the building and in other buildings of the plant.

The foundry will be operated on the unit system. Each floor will handle its own sand, molds and shakeout. The molders in all of the light and medium work will devote their entire time to molding. A pouring gang will pour off, and another gang will shake out, collect castings and deliver them to the cleaning room. A sand gang will cut the sand, screen it, temper it and prepare it for the molder. Careful analysis of labor costs under this system were available from the records of the old foundry, which was operated on exactly these methods. These costs were compared carefully with the records of other plants and it was found that under this method less hours of labor were required to produce a ton of castings, where similar work was being produced, than by any other method.

The castings will be delivered from the molding floors to the cleaning room by any one of several methods which may prove desirable. Skips handled by the electric crane or monorails, or by elevating trucks can be used, and naturally the heavy castings will be loaded on cars by the cranes in that way, and pushed into the cleaning room by the 15-ton Goodman storage battery locomotive, and there distributed by cranes. Heavy duty storage battery elevating trucks made by Baker, R. & L. Co., Cleveland, will be used to handle cars into and out of the Holcroft ovens and also to deliver them outside where needed.

In the cleaning room the tumblers are arranged in batteries of four and the travel of all of the light castings has been decided definitely from experience in the old foundry, with certain modifications which give increased economy. Each battery is driven by a large Fairbanks-Morse motor operating through a pinion through a large gear wheel, exerting a flywheel action. The gear wheel drives a live shaft, supported by ample bearings. Pinions operated through Fairbanks-Morse clutches engage with the barrels. Each barrel is equipped with its own clutch and brake, whereby after throwing out the driving clutch the tumbler may be locked in a certain definite position. This insures against any barrel being put in gear accidently or moving when being loaded or discharged. All of the grinders are driven by individual motors and the exhaust pipe for both the grinders and tumblers are carried underneath the floor to dust arresters installed in the roof trusses. The dust arrester equipment was made by the W. W. Sly Mfg. Co., Cleveland.



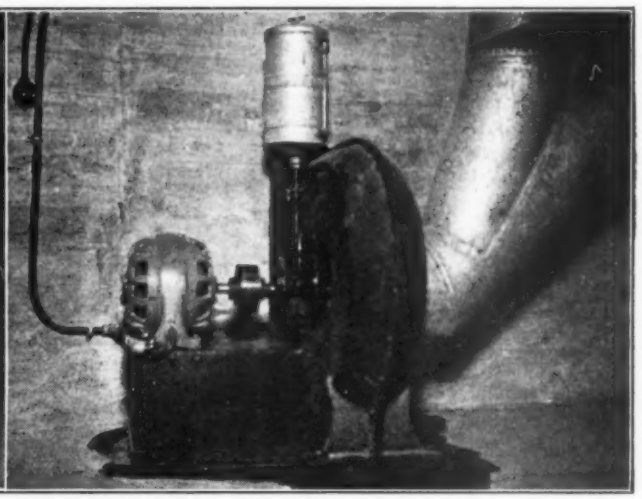


FIG. 15—THE OVENS ARE STOKER-FIRED IN PITS, COAL BEING DROPPED DIRECTLY TO THE HOPPERS SHOWN FIG. 16—BOOSTER FAN INSTALLED TO SPEED UP OVENS IN BATTERY C

Disposing of Cleaning Refuse

Mr. Barr and Mr. Hardy decided that as the cleaning room was divided into individual floors, each handling its own class of work, it would be practical to make each gang take care of its own refuse, provided a simple method were installed. As a consequence, in operation, each gang will be required to clean up its floor collect the burnt sand and refuse into a thin pile for which ample space was allowed. When thus prepared, the overhead crane will pass a large magnet over the pile and take out the core rods, core wire and iron which is profitable to reclaim. After this is done, the crane will carry the metal over to a side-dump car and dump it into a hopper car. This car is then to be taken by electric locomotive to the proper department, where such of it as is worth reclaiming is separated. The core rods and core wires which can be of service again will be sent back to the straightening department and distributed to the coreroom. The other scrap will be passed back into the cupola bay and melted.

After the metal is removed the workmen will be required to shovel this sand to a small grating covering a bottom dump bucket, located in a pit on their floor. This bucket has a capacity of three cubic yards. When full, the overhead crane picks the cover off the pit, takes up the bucket, carries it to the material track and dumps this waste sand into a side dump car. It then is transferred to the foundry dump and disposed of. It has not been found economical to attempt to reclaim any of the core sand, even from large cores.

Fairbanks-Morse scales are provided at convenient points in the cleaning room for weighing all of the castings produced.

For the proper storage and handling of flasks a flask yard extending the entire length of the foundry on each side has been installed. Flasks are loaded on to cars, pushed out under a 5-ton crane serving these flask yards, piled in proper place and brought back into foundry as required. These flask yards are 300 feet in length and are covered by 5-ton cranes, manufactured by Milwaukee Electric Crane Co., Milwaukee.

All of the traveling cranes are equipped with 440-volt, alternating cur-

rent, crane motors, controllers and two-torque load brakes manufactured by the General Electric Co., Schenectady. The plant is equipped with 10, 15 and 25-ton cranes in the various bays. The 15 and 25-ton cranes were made by the Whiting Corp., the 10-ton cranes and the material crane by the Toledo Bridge & Crane Co., Toledo.

All the other machinery in the plant is driven by 440-volt, alternating current, Fairbanks-Morse motors of various sizes. Special motors with high starting torque were developed for handling the ventilating system. Throughout the plant nothing but alternating current is used, except on the magnets where direct current is required.

Offices at the Side

The offices are on the ground floor between the material bay and the main foundry, and are fully equipped with toilet and locker rooms for both male and female office employes. A thoroughly equipped restroom is provided for the women. Adjoining the main offices, are the time clock and check-in. Workmen come in through the main entrance, pass upstairs through locker and toilet rooms and then pass down past the time clock and into the foundry.

The locker room for men is fully equipped with steel lockers, wash basins and sanitary plumbing. An attendant will be in charge with proper checkroom for keys. Separate baths and other conveniences are provided for colored labor. The foremen's offices with their own toilet, bath and locker facilities adjoin the main offices. A well equipped first-aid station with beds, operating tables and all other necessary equipment, which will constantly be in charge of a competent staff, adjoins the main offices. This will be operated as an auxiliary of the main first-aid station for the entire plant.

A small machine shop for taking care of light repairs and ample storage room for handling of working patterns is provided in the cupola bay.

An elaborate cafeteria and recreation room was erected several years ago, near the main offices of the plant. This cafeteria contains exceptionally complete cooking and storage apparatus. For the convenience of the foundry, meals will be cooked at the main cafeteria, and delivered in suitable at the foundry cafeteria, and there served. The foundry cafeteria is located on the second floor at the opposite end from the main offices, and is equipped with steam tables, dish-washing machinery and serving tables of the latest design.

Semisteel Not Low in Total Carbon Contents

To the Editor:—The writer was greatly interested in your editorial entitled "Seek Rational of Semisteel" on page 36 of the Jan. 1 issue of THE FOUNDRY, as it is in line with our findings in actual practice.

We are in touch with hundreds of foundries and the writer personally has visited many the past few years and agrees with you that semisteel can be mistreated by poor cupola practice plus the manner in which the metal is handled after it is melted.

For instance, in one case where the semisteel castings were frequently too hard, the writer found the melting conditions and the estimated mixtures correct but part of the molten metal was taken away before the whole charge had been thoroughly mixed in the receiving ladle and, as the steel melted first, no doubt all of the steel was in the first tap of 900 to 1000 pounds instead of 2000 pounds as contemplated. This, of course, would not give the results sought.

You state that "reasons have been advanced for this strengthening of the product by the addition of steel to the cupola, but none has been universally accepted in the metallurgical world. One of these is that the addition of steel reduces the carbon in the resulting metal."

Some years ago I became interested in the claim that steel when added to cupola mixtures reduces carbon, but as I had learned in my steel foundry practice that steel will absorb carbon from a coke facing, I believed if steel were melted in conjunction with coke, carbon would be absorbed, which proved to be a fact.

The following is a 30 per cent steel mixture now being used in a cylinder foundry. The calculated carbon in the charge and that found in the resulting semisteel are also given.

	Per cent carbon
600 lbs. steel	0.20
1400 lbs. pig and gray iron scrap	3.40
0.30 × 0.20 = 0.06	
0.70 × 3.40 = 2.38	
	2.44

	Per cent carbon
Estimated analysis	2.44
Castings contained	3.46

The following 50-50 mixture for heavy cylinders, in the same foundry, also illustrates the extent to which carbon is picked up by the steel:

	Per cent carbon
50 per cent steel	0.20
50 per cent pig and gray-iron scrap	3.40
0.50 × 0.20 = 0.10	
0.50 ×3.40 = 1.70	
	1.80

	Per cent carbon
Estimated analysis	1.80
Castings contained	3.32

Steel scrap alone will not insure increased strength in semisteel. It is obtained by scientific melting and blending of the various elements of the steel and gray iron, there being a reduction of the injurious elements. Every pound of steel added to a cupola mixture reduces the percentage of pig required which, owing to the purity of steel as compared with gray iron or pig, naturally decreases the percentage of weakening elements or impurities. Strength, homogeneity, density and machinability are increased, thus, semisteel has been referred to as the connecting link between gray iron and steel.

The essentials in making semisteel are:

1.——A practical knowledge of metallurgy.

2—The science of melting steel and iron.

3—Keeping the elements in proportion to suit the section of casting.

4—Steel scrap, plus manganese to remove oxygen.

5—Care in handling metal after it is melted.

6—Granular form of graphitic carbon instead of the flaky form.

DAVID MCLAIN,
McLain System, Inc., Milwaukee.

Book Review

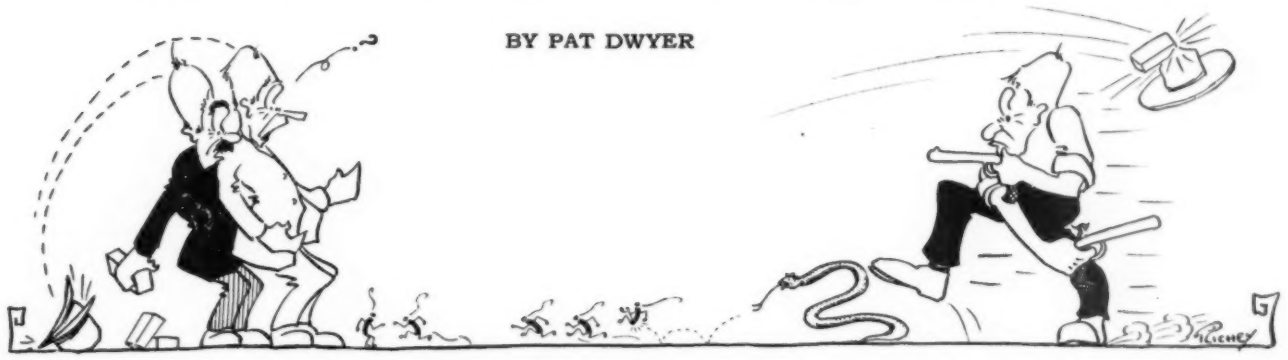
Proceedings of the twenty-fourth annual meeting of the American Society for Testing Materials, htld at Asbury Park, N. J., June 21-24, 1921; cloth; 1198 pages, 6 x 9 inches; published by American Society for Testing Materials, 1315 Spruce street, Philadelphia, and for sale by THE IRON TRADE REVIEW; price $10, net.

This volume of *Proceedings* contains committee reports, new and revised tentative standards, and technical papers presented at the last annual meeting of the American Society for Testing Materials. The meeting is briefly summarized in the first part of the book and the president's annual address and the report of the executive committee are given in full. The next section is devoted to reports of committees including those on ferrous metals; nonferrous metals; cement, lime, gypsum and clay products; and miscellaneous materials. Tentative standards submitted at the 1921 annual meeting are published, including those pertaining to ferrous metals; nonferrous metals; cement, lime, gypsum and clay products; preservative coatings; petroleum products and lubricants; road materials; coal and coke; insulating materials, shipping containers; textile materials; and miscellaneous subjects. Twenty-four technical papers, a list of society officers and members of the executive committee and an index complete the book.

D. M. Thorpe has been transferred from the Philadelphia office of E. J. Lavino & Co. to the Pittsburgh office at 1922 Oliver building where he will handle the sales of chrome ore, chrome brick, magnesite brick, etc.

Bill On Pattern Mounting Methods-I

BY PAT DWYER



TAKING it by and large—a fine comprehensive phrase—I should be inclined to say that probably from first to last I must have read about a million stories of one kind and another. They ranged in style and general characteristics all the way from the thin, paper-covered masterpieces dealing with the life and adventures of Old King Brady, down, or up, depending on the point of view, to the solid, substantial, morocco bound autobiography of the Baron Von Bunkum entitled "Forty Years in the Treadmill of European Politics." Merely as an expression of opinion and without attempting in the least to influence the reader's opinion in his or her choice of literature I feel that I am entirely within the bounds of truth when I say that Old King Brady furnished more thrills per page than any other hero of fiction within my recollection. 'Tis true he flourished in the days before automatic revolvers were invented and he had never seen an automobile; but, he never failed to bring in his man, sometimes dead and sometimes alive, but he brought him in and on each occasion cleared up one of the most baffling mysteries that ever confronted the metropolitan police of New York. He never shot except under the most extreme provocation. Bullets might bury themselves in the walls and splinter the woodwork all around him without disturbing his equanimity or altering his determination to capture the villains alive; but when a bullet carried away his famous old gray hat, he always decided that the time for severe and drastic measures had arrived. The human eye could not follow the lightning like rapidity of his movements. Where a moment before an apparently unarmed defenseless old man occupied the doorway, there now stood a grim figure, with death and destruction leaping in a living flame from a heavy navy revolver held in each hand. At every crack a miscreant bit the dust, irrespective of whether he fell backward or forward. Having examined each one and satisfied himself that he had driven the bullet fair and true midway between the eyes in each case, he hastily removed the diamonds, or the documents as the case might be, from the inner pocket of the leader and then having reloaded his weapons and returned them to their secret hiding place on his person, he blew his silver whistle and summoned the police patrol to cart the carrion to the morgue.

Frequently during my school days, when my reading was confined altogether to this brand of literature, and for that matter many times since that time, I have heard and read statements made by well meaning people to the effect that sensational *trash* of this character would ruin a boy's mind and land him eventually either in a penitentiary or an asylum for the feeble minded. All wrong mates, all wrong. Of the dozen or more boys with whom I was particularly intimate, only one was warned by his loving parents against the pernicious influence of that kind of literature. He grew up without ever having opened one of these snares of the evil one What was the results? Ah, ha! I ask you again, my, friends, what was the result? Every one of those boys, with the single exception of the one who would not read a dime novel, is today a prosaic, matter of fact ordinary citizen and father of a family.

The good little boy grew up and ran away from home in the first rush for the Klondike. He didn't waste his time, or freeze to death prospecting in the wilderness for gold. Not he. He stayed in town and made a nice living playing the piano. Eventually he became proprietor of a place of his own and at the end of ten years, well fixed in the world's goods, he came east on a visit to the old homestead. He stopped in New York to give the Great White Way the once over, as the saying goes, and whether the sight affected his mind, or whether the brand of liquor dispensed thereon had a more vicious kick than the Alaskan variety to which he was accustomed, never definitely has been decided. Anyway, at the present time, with malt and spirituous liquors only a memory, what difference does it make? After a week in New York he was taken to a hospital and died in the horrors. Well, there you are.

Judging others by myself, which after all is about the only way they can be judged, I should say that a man does not read a story for the sake of the profit he may derive. He reads it simply for pleasure and is not over-critical whether some of the statements or situations are either accurate or reliable. If he does discover a glaring misstatement only one man in a million will direct the poor author's attention to it. Fiction writers usually are gifted with vivid imaginations. If they were not so gifted they would not be fiction writers. Consequently little details like accuracy and truth are not allowed to hold up the even flow of the sheets through their nimble typewriters. If readers were in the habit of taking every printed word seriously, they could gather some choice gems of misinformation occasionally from books and magazines rated in the highest class and with a circulation reckoned in

HORATIO ALGER WAS HIS FAVORITE AUTHOR

seven figures. I came across an instance the other night while reading an otherwise interesting story and while I mentally classified the author as a poor nut,—a term of course I never would think of employing publicly,—I did not sit down to write him and probably would have thought no more about it if Bill had not dropped in about that time to smoke the pipe of peace.

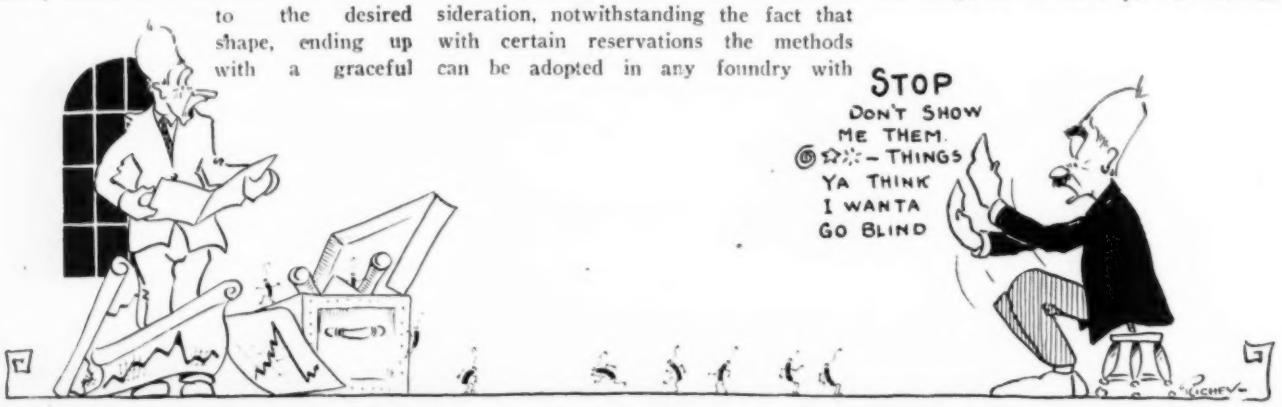
The hero of the romance was superintendent of an open-hearth plant somewhere in Pennsylvania and for the faithful performance of his duties was paid $50,000 a year. The value of a man's services or the extent of his remuneration cannot be determined accurately by an outsider, but I felt fairly confident that if the owners were to look around a little they could fill the position at a considerably reduced figure. However, I am not an open-hearth man and the statement did not interest me one way or another. What particularly attracted my attention was the passage in which the hero explained to his lady love the manner in which an open-hearth furnace functions. I realize that I am only human and therefore liable to make mistakes; but a more or less intimate acquaintance with open-hearth furnaces over a period of many years has left me under the impression that they are used to melt down a charge of iron and convert it into liquid steel which then is tapped into a ladle and poured into ingots or castings, depending on whether the furnace is operated in conjunction with a rolling mill or a foundry.

Our hero's furnace was not operated in that manner. Far from it. In a few short descriptive sentences, he painted a realistic picture of how the glowing masses of steel are withdrawn from the furnace, of the mighty crane with the strength of a giant and the deftness of a watchmaker, which places the steel under one of the Titan hammers, where it is crushed and kneaded to the desired shape, ending up with a graceful tribute to the skilled and brawny workmen, stripped to the waist who assist in the manipulation and who have contributed their share to making this known as the Age of Steel. I suggested to Bill that it was incomprehensible to me how any man in this day and generation, with any pretense to general knowledge could display such ignorance of the methods involved in the manufacture of steel. Further, if he was not familiar with the process, a few minutes reference to any encyclopedia would have been sufficient for his purpose.

IMPROVED METHOD FOR MAKING PIG IRON

"It seems to me" said Bill "that the whole thing simmers down to this. The average person reads principally for relaxation. If the author's views coincide with his own he feels mildly gratified. If the author makes a statement opposed to his observation or experience, he either mentally waves it aside or puts the author down as a person who should have a guardian appointed to look after him. In either case he promptly forgets all about it the minute he puts the book out of his hand. This applies not only to fiction, but to a certain extent also to technical literature. Laying generalities aside and coming right down to a concrete example how many foundrymen are familiar with the methods of making matchplates, or of mounting patterns on plates to be used with molding machines? Outside the specialty shops this is a subject that has received scant consideration, notwithstanding the fact that with certain reservations the methods can be adopted in any foundry with gratifying results. They reduce costs in the shape of time and labor expense and produce better castings.

"Molding manufacturers have issued brochures describing the process. Papers dealing with the subject have been presented several times before conventions of the American Foundrymen's association. Illustrated articles describing specifically and in detail some particular phase have been published from time to time in THE FOUNDRY for a number of years. Indeed it is rarely an article on foundry practice appears in which reference is not made directly or indirectly to the economical benefits to be derived from this particular piece of foundry equipment. With such an apparently wide measure of publicity you would think that foundrymen generally would be familiar with methods for mounting their patterns to secure economical production. Are they? You tell 'em sandblast, you have the grit. Many foundrymen are under the impression that the adoption of any kind of special pattern equipment entails an enormous expenditure for special flasks. They are accustomed to fitting up each pair of copes and drags individually and the idea of attempting to make all the copes and drags of one size, interchangeable seems to be an extra refinement for which there is no justification. Usually, the flasks are made by the foundry carpenter, one of those rough and ready birds who view with honest suspicion any person discussing terms of measurement in figures less than ¼-inch. The same holds true to a certain extent in the case of iron flasks, especially in those cases where the foundry is not operated in connection with a machine shop. In some cases, gaps are provided in the flanges and it is relatively simple for the molder to jam the toe of a short *U* clamp in the gap on one flange and drive a wedge between the lower toe and the flange on the other part of the flask.



WITH A FLOCK OF CHARTS A MAN CAN PROVE ANYTHING TO HIS OWN SATISFACTION

Even in cases where two or three pin holes are drilled in the flanges with a ratchet drill, no attention is paid to spacing them symmetrically. So long as each pair of holes come opposite each other the fitter thinks he has done all that reasonably could be expected. Rolled steel flasks, accurately fitted and interchangeable in small and medium sizes are made by several manufacturers of foundry equipment and probably can be secured for less than the indiviual foundryman can make cast iron flasks in his own foundry.

"Probably the only foundry in which pattern plates, matchplates and other devices of a like character cannot be employed extensively, is the jobbing or manufacturing foundry operating on large heavy work. The two principal objections to their adoption in a foundry of that description are that long running jobs are the exception and not the rule and many of the castings are made either by sweeping molds in loam or by bedding a pattern in a pit in the floor. However, even in this shop many of the smaller castings are made in sufficient quantity to warrant a special rig, such for instance, as mounting each half of a split pattern on a flat board and ramming the cope and drag individually instead of ramming the cope on top of the drag.

"One of the principal economic advantages of this arrangement of the pattern is that if necessary two men or two gangs of men can be worked to better advantage. According to the rules of mathematics four men should do four times as much work in a day as one man. Perhaps they will under certain conditions, but I am here to tell the world that four men working on one pattern will *not* do as much work in a day as four men working on four individual patterns will do in the same length of time. The same rule holds in all instances. Some jobs are too big to be handled by one, or even three or four men. If it is found by experimer at five men can be worked to advantage on one pattern, it also will be found that if the number is increased to nine or ten that the per capita output is decreased."

"Stick to one thing Bill" I said "Stick to one thing. If you want to talk about methods of mounting patterns I am willing to give you my undivided attention, but if you are going to start in on that efficiency dope, I believe that is the word, its all off. I have heard and read so much on that subject in recent years that I am as our British friends say, jolly well fed up with it. The first thing I know you will be dragging out a flock of charts to prove that there are twice as many foundries in this country as there were forty years ago and therefore they must be only half as efficient as they were at that time."

"To tell you the truth" said Bill "I never considered the subject in that light before and perhaps there is something in it. However I am not prepared to go into it at this time. For that matter I shall need a few sketches to illustrate what I want to say about pattern mounting methods. I think I have a few somewhere around the house and if you are interested and will come over some night I'll show you the ingenious methods worked out along that line by some of the cleverest lads in the business."

Dayton Malleable Company Buys Canton Plant

Purchase of the Canton, O., plant of the Timken-Detroit Axle Co., has been made by the Dayton Malleable Iron Co., according to an announcement by John G. Haswell, president and general manager of the Dayton company. The transfer becomes effective Feb. 1 when the new owner will begin alterations. Changes in machinery are to be made as the Dayton company plans to enlarge the scope of production of the shop in heavy malleables. The plant was built in 1916 for the manufacture of malleable iron parts for automobiles. Officers of the Dayton Malleable Iron Co., which has been in business since 1866, include beside Mr. Haswell, H. D. Hunter, vice president in charge of sales, and W. B. Runyan, vice president and general superintendent. The Timken-Detroit Axle Co. will in the future maintain its plant in Detroit according to Walter McGregor, general manager at Canton.

Book Review

A Course in Mechanical Drawing, by Louis Rouillion; cloth, 7½ x 6¼ inches published by the Norman W. Henley Publishing Co., 2 West Forty-fifth street, New York and furnished by THE FOUNDRY for $1.50 net.

The author of this practical treatise on the art of making working drawings, lettering and dimensioning, is director of Mechanic's Institute, New York City; author of Drafting of Cams, and Economics of Manual Training. The book, of which this is the fifteenth edition, is the result of a number of year's work with evening classes and has been evolved from a careful study of the needs of such classes. The course originally was issued in blue print form with accompanying typewritten notes. In this form it has been in use in Pratt Institute and other schools and in Y. M. C. A. classes for some years. In a modified form it has been published serially in *Machinery*. In its present form it is suitable either for school use or for self instruction. It makes a peculiar appeal to the teacher in that it affords a definite, logical and sequential course. It is not a reference book of miscellaneous facts, but a stated course, the result of years of teaching the subject. All superfluous matter has been eliminated; but each chapter is complete in itself. For the benefit of students wishing to use the book for self instruction, each lesson is presented so clearly that he can readily understand it. The book is particularly adapted for the course in drafting taught in evening and vocational schools. Because of the interest evinced by pupils in isometric drawing this subject has been added to the present edition. The exercise given at the end of the book, form a parallel, independent course permitting the use of the book as a text book in class work.

Sells Malleable Foundry

The General Malleable Co., Warren, O. has sold its plant and property to the Warren Tool & Forge Co. of that city. The purchase of the American Block & Mfg. Co., also of that city gives to the Warren Tool & Forge Co. a more complete equipment for the manufacture of railroad and contractors equipment. The General Malleable Co. in future will be known as the Malleable Division of the Warren Tool & Forge Co. and a large portion of its capacity of 600 tons of malleable castings per month will be used by the purchasing company. The officers of the new organization, which is capitalized at $1,800,000 are: President James D. Robertson, Pittsburgh; vice president, M. J. Konold; treasurer and general manager, George Konold, and secretary, George F. Konold Jr. The latter named officers are residents of Warren.

British Requirements for Cylinder Castings

The British Engineering Standards association specifications for water-cooled aircraft-engine cylinders includes both chemical and physical tests. The chemical requirements are as follows:

	A Per cent	B Per cent
Combined carbon..	0.50-0.80	0.50-0.80
Total carbon	2.70-3.50	2.70-3.30
Silicon	1.20-1.80	1.20-1.80
Manganese	0.80 maximum	1.10 maximum
Sulphur	0.12 maximum	0.12 maximum
Phosphorus	0.35-0.80	0.60-1.2

The physical specification calls for a ⅞ inch test bar to stand 12 tons (26,880 pounds) per square inch.

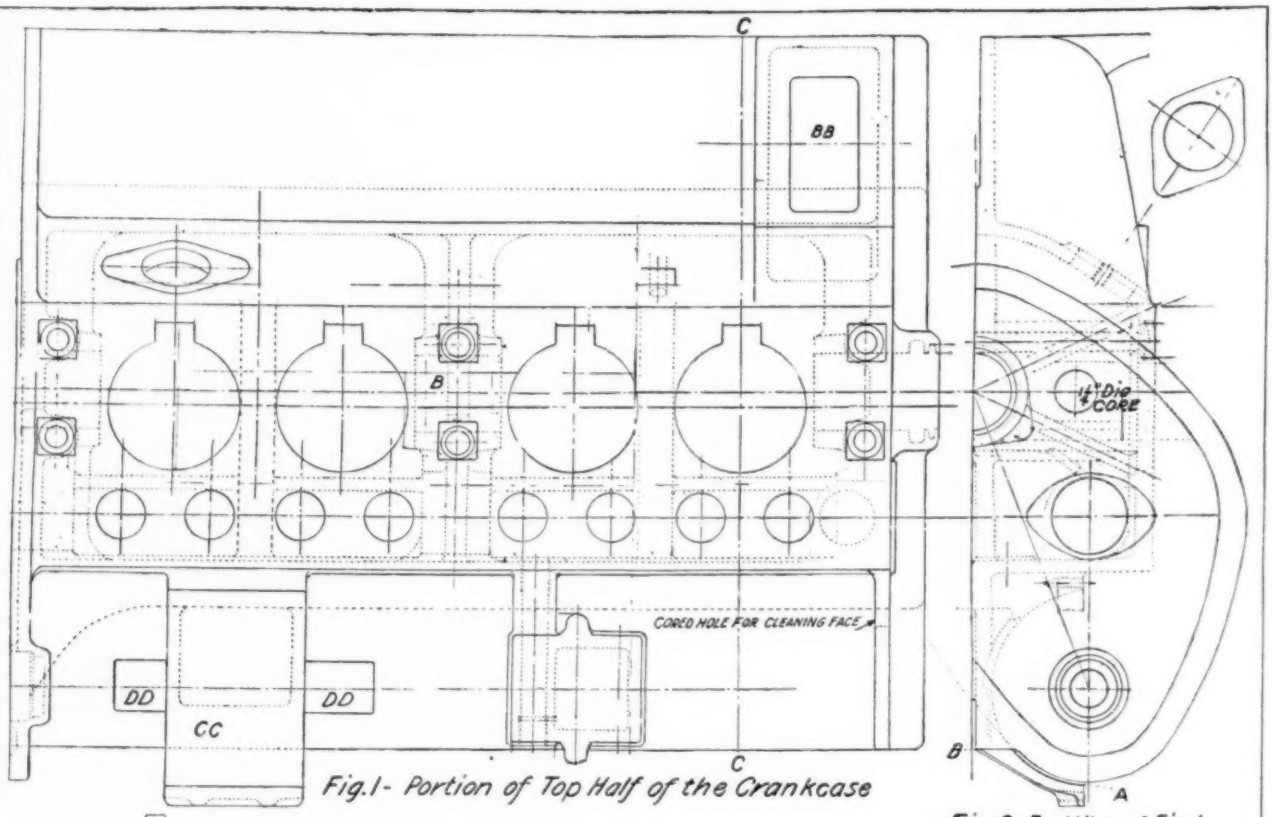


Fig. 1- Portion of Top Half of the Crankcase

Fig. 2-End View of Fig. 1

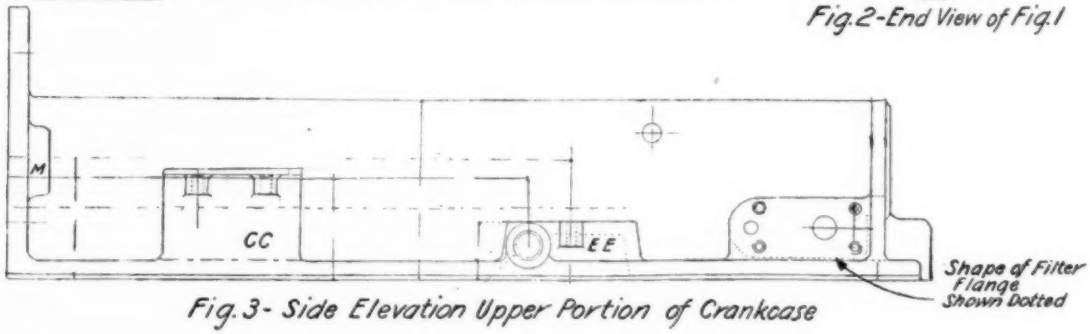
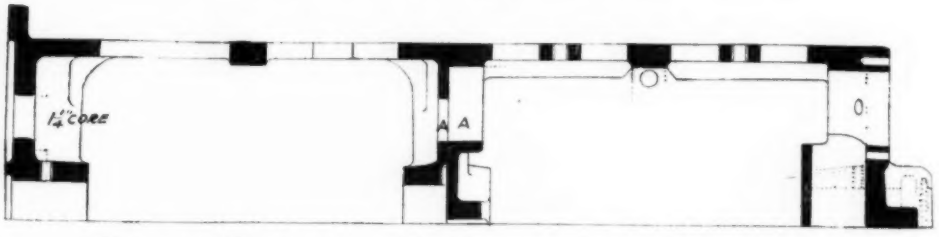


Fig. 3- Side Elevation Upper Portion of Crankcase



Section at B-B Fig. 5 Fig. 4 Section at A-A Fig. 5

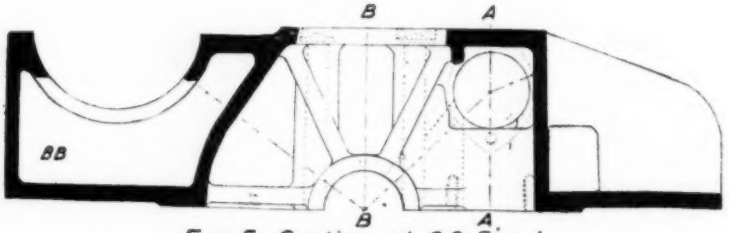


Fig. 5 Section at C-C Fig. 1

FIG. 1—TOP HALF OF THE CRANKCASE FIG. 2—END VIEW OF FIG. 1 FIG. 3—SIDE ELEVATION, UPPER PORTION OF THE CRANKCASE FIG. 4—SECTIONS AT *AA* AND *BB*, FIG. 5 FIG. 5—SECTION AT *CC*, FIG. 1

British Motor Castings Methods-III

Making of the Patterns and Coreboxes for a Typical Crankcase Casting Is Dealt with—Detail and Reasons are Given for the Methods Recommended

BY BEN SHAW AND JAMES EDGAR

IT IS usual to regard the cylinder as the most difficult casting of an internal combustion engine, but although the coring may require more careful watching than with the crankcase, the pitfalls into which the patternmaker or molder may fall are as numerous in the one case as in the other. Even the highly skilled craftsman on a first examination of the average crankcase drawing may find it more awkward than the average cylinder. The reason for this is that so many dimension lines are necessary. The crankcase, the top half of which is shown in Figs. 1 to 5 is quite a representative type. It is made of aluminum. Much variation of detail is found in crankcase design, but there would be no gain in showing several designs, as all have to conform to general principles, and the object of these articles is not so much simply to describe a few jobs but to describe them in such a way that the reader will get a grasp of the underlying principles of construction which are most suitable for this class of work.

In setting down the work the patternmaker should not just copy the blueprint, but should put as few lines as possible on the drawing board. Some patternmakers put far too much detail in the working drawings and thus lead to confusion on the part of the assistants. The main outline should be set down giving metal thicknesses, and branches and feet should also be shown, but small bosses and ribs may conveniently be left off. These easily can be picked up from the blueprint.

Should Not Continually Refer to Print

When the patternmaker's drawing is completed it should not be necessary for him to continually refer to the print. Such references indicate a lack of confidence in his own drawing and may lead to serious mistakes. Even if a first class drawing is provided by the drawing office the patternmaker has to use his own judgment in matters of detail, and this applies not only to one but to all classes of work. Thus the workshop drawing may differ in some respects from the print and inaccuracies may occur especially if assistants refer much to the print. It is the practice of some patternmakers to allow no one to look at a drawing except the man responsible for the work, and although there are important objections to this, something may be said for it.

Should Replace Board

It may be in place here to say a word or two about the kind of drawing board that should be used for this fine medium sized work. In a patternshop doing big engine work or machine tool work the drawing boards are not always such as could be desired. Great accuracy cannot be obtained by drawing on a board, the whole surface of which is scratched with scriber lines, and this is the great objection to the blackboard which is never replaned. However, if a blackboard is smooth, it is really preferable to a white surface. The best drawing board for fine work is undoubtedly a three ply board. There are no joints and the surface is hard.

A contentious point often in setting down is the number of views that should be shown. In producing first class patterns time spent in making an accurate and full drawing is never wasted. Under no circumstances should views be drawn one on top of the other as is often done when making large patterns. The practice is objectionable chiefly because of the thickness of the metal. Each view should be drawn in correct relation to the others and the machining marked on finally. On no part should it be necessary to leave more than ⅛-inch for machining purposes.

In constructing the pattern for the crankcase, shown in the accompanying illustrations, it should be borne in mind that the main flange will be down in the mold. This is advisable for several reasons, one being that a clean face on the joint flange is desirable, and another that it facilitates coring the job in the foundry. As with the cylinder described in a previous article all loose pieces should be dovetailed where possible, both to save the molder trouble in loosening off and also to ensure that they will be replaced correctly.

The first operation in making the pattern is in jointing the flange, which forms the base of the pattern. It is extremely thin and thus does not lend itself to a half lapped joint. It is rather peculiar that patternmakers doing this class of work seldom use half lapped frames. The objection is quite reasonable here if the spaces between the ribs will not be closed or covered, but the half lapped frame where possible is certainly the strongest joint. The method of jointing two or three thicknesses edge to edge and insetting cross battens half the thickness is not recommended with so thin a plate, and undoubtedly the best plate is obtained by doweling as shown at Fig. 6. Thin pieces—*slithers* they are sometimes called—should be temporarily inserted between the boards, the dowels being glued. Patternmakers who believe in open joints frequently close dowel joints, because presumably they are afraid of the glued dowels not being sufficient to prevent them from being knocked together. The dowels are not really a source of strength, but should be regarded as a convenience while planing and shaping the flange. To prevent an accident it is advisable to screw battens on this plate while cutting the recess to leave the facing. It is much better to mark the flange to full thickness over the facing than to make the facing separately, as it so thin.

Ribs Not on the Joint

Attention may be drawn to the fact that the ribs which support the bearings at the ends and center are not on the joint. It would not be a safe job to attempt to core under these ribs therefore the 3/32-inch for machining is cut from the flange face and the main print is formed to the rib outline.

The body of the pattern might be in one thickness of lumber if lumber sufficiently thick is available, but if not, it would have to be jointed up. It is too small to be boxed. Figs. 7 and 8 illustrate different methods of building the body block. It may be noted that the back-to-back principle with the annular rings tangential is observed. Fig. 8 shows the much better way. There can be no interference with molding caused by a top hori-

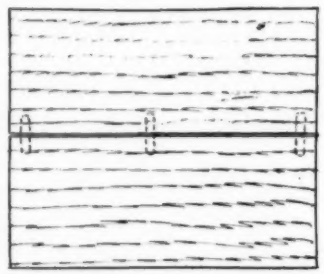
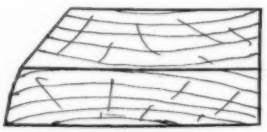


Fig. 6
Method of Doweling



Method of Building Body Block

Fig. 7

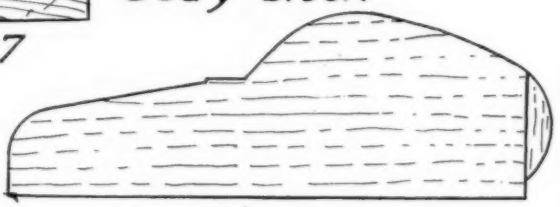
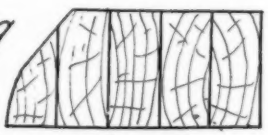


Fig. 9
The Loose Piece Should be Screwed On



Method of Building Body Block

Fig. 8

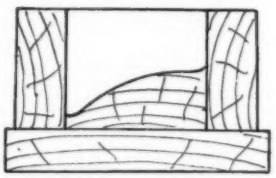


Fig. 10
Cross Section of Box for C C Fig. 3

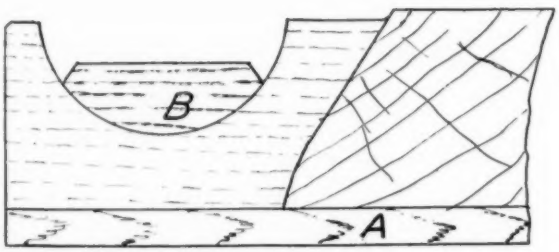


Fig. 11
Method of Locating the Bearing Core

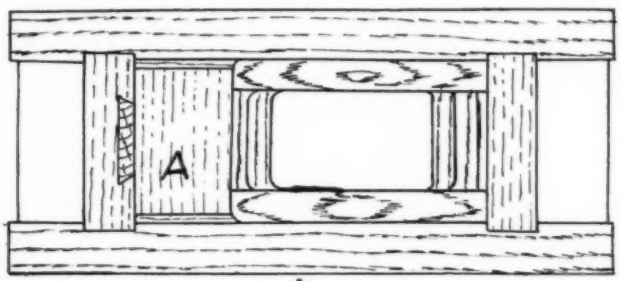
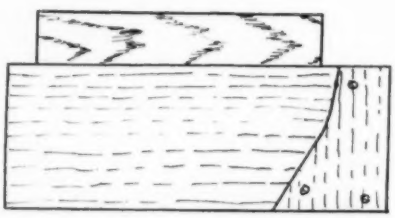


Fig. 13
Plan of Box for B B Fig. 5



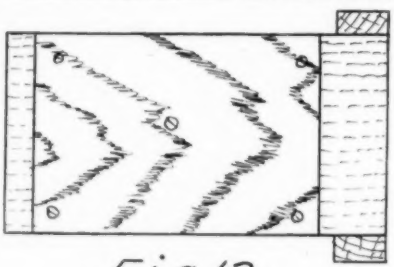


Fig. 12
Printed Pattern Avoids Loose Piece

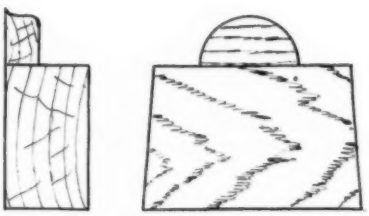


Fig. 14
Block Print

FIG. 6—METHOD OF DOWELING FIGS. 7 AND 8—METHODS OF BUILDING BODY BLOCKS FIG. 9—THE LOOSE PIECE SHOULD BE SCREWED ON FIG. 10—CROSS SECTION OF BOX FOR *CC*, FIG. 3 FIG. 11—METHOD OF LOCATING BEARING CORE FIG. 12—PRINTED PATTERN AVOIDS LOOSE PIECE FIG. 13—PLAN OF BOX FOR *BB*, FIG. 5 FIG. 14—BLOCK PRINT

zontal part swelling more than a bottom part and if the lumber is carefully jointed and good glue is used it will retain its shape as long as the pattern can be used.

In order to bind the pattern well the end flanges should each be made of one plate, which is much better than taking the block for *BB*, Fig. 5, to the face and fitting the flange against it. The loose piece in Fig. 9 should be wired or screwed on as they are too thin to be dovetailed.

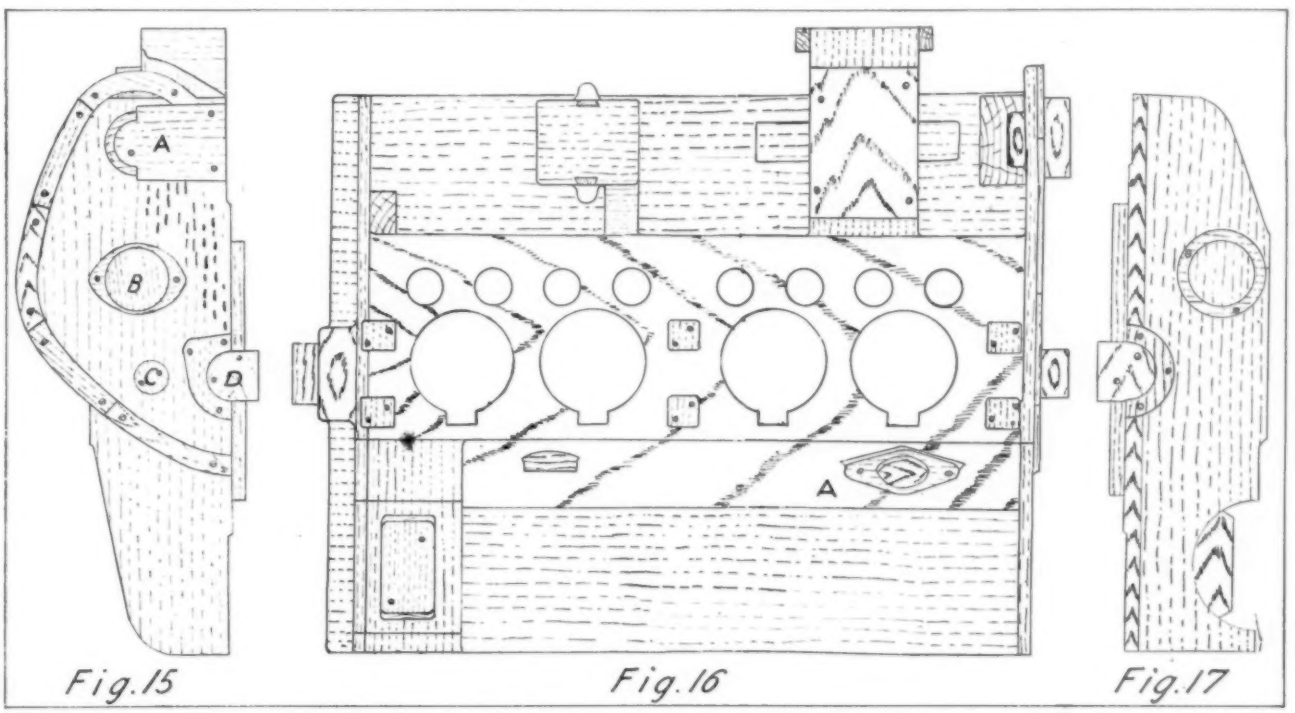
We shall now consider the block *BB*, Fig. 5. It would be possible to core the whole of this block but it would not be a neat job. The bearing core would in any case have to be made in a separate box printed so that the under core would rest on it. The trouble that would be involved in the foundry to do this is obvious, hence it is suggested that the method shown at Fig. 11 is the better way. Here *A* is a batten which is fitted into a cheek cut across the main block and thus binds the two parts together, while *B* is the print for the bottom core. The two blocks *CC* and *EE*, Fig. 3, are still to be made. The block *EE* is comparatively simple. It is shown with the *D*-shaped boss as being cut from the same piece of lumber which is more satisfactory as reducing the number of pieces for final assembling. The less pieces in which a pattern is made the better, other things being equal. The small bosses could easily be dovetailed. The fillet at the base of the block could be made quite well from leather. The print for this block is, of course, on the face of the flange as the core breaks through on the face.

Fig. 12 represents one of the trick pieces of the patterns. The experienced patternmaker might decide that as long as the piece projecting, which prevents delivery from the sand, is dovetailed on the body and a core made for the inside, there would be no difficulty. It is not uncommon for a foundry to receive a pattern beautifully made with all loose pieces dovetailed but with one part so arranged that coring is impossible. The foreman patternmaker in measuring work sometimes overlooks a point like this because he is so intent on measuring for accuracy. By referring to Fig. 2 it may be seen that the edge of the core at *A* projects considerably beyond the edge of the bottom flange and it would thus be impossible for the molder to set in the semicircular core unless by making a drawback on the outside, However, as drawbacks should be ruled out on repetition work, if at all possible, this matter may be dismissed. The only practical way then of surmounting the difficulty is to print the outside as shown in Fig. 12. If the print is made wider than the block the core cannot be misplaced.

We shall not trouble explaining in detail many small bosses and facings on the pattern. The circular facing *M*, Fig. 3, is an instance where it is not sufficient to keep a facing loose as it is too thick for the molder to draw into the flange, after the main pattern has been drawn from the mold. There is a choice of two methods; either the facing may be made of two thicknesses, each part being thinner than the flange, or print can be made to the center. In this class of patternmaking the former method should never be employed. It is seldom that a neat result is obtained and the molder is caused considerable trouble. Making a loose piece in two thicknesses is only excusable with rough work, or in the case of a rush job, when one or two castings are required in the shortest possible time. If a block print, Fig. 14, is made, the corebox and core do not occupy much time in making and there is the additional gain that there is one loose piece less on the pattern.

Some craftsmen favor the practice of screwing each part to the base plate as it is made, while others prefer to have all parts completed before assembling. The latter method necessitates close watching and the man who has not the gift of visualizing in a marked degree, or is not quite confident of his own skill, usually builds as he works. The method of final assembling is certainly the better way if two or more workmen are engaged on the job, and when this is the case only the man responsible for the work should screw it together.

Every endeavor should be made in building a pattern like this to do without cheek or pocket screws. This



FIGS. 15, 16 AND 17—THESE THREE ILLUSTRATIONS REPRESENT THE FINISHED PATTERN

method of fastening is admissable on large work but it is a clumsy and not always accurate method of dealing with small work. We have shown how the block *BB*, Fig. 5, may be held by a tongueing, crossing the block or flange should be as completely finished as possible. The facing on the end flange, Fig. 9, should be screwed on, for instance. This facing should be left loose in sections in order that the molder can draw it into

15, 16, and 17 are different views of the finished pattern. In Fig. 15 it may be noticed that while a tail print has been used for the core *A* the holes *B* and *C* have ordinary round prints. The reason for this will be made

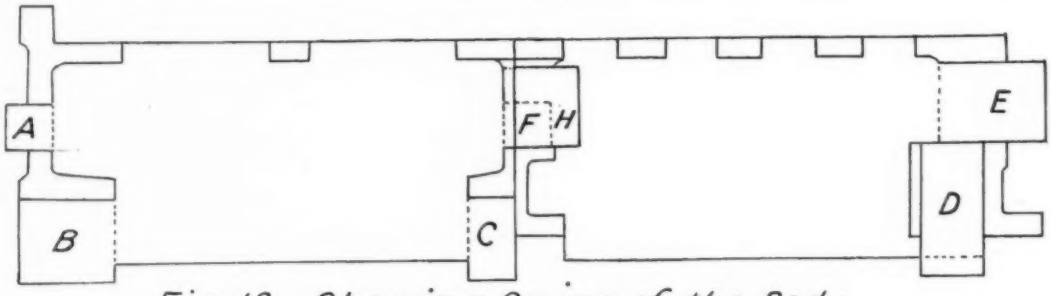


Fig. 18 - Showing Coring of the Body

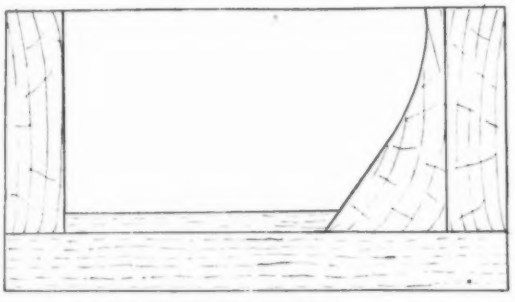


Fig. 19
Section of the Corebox

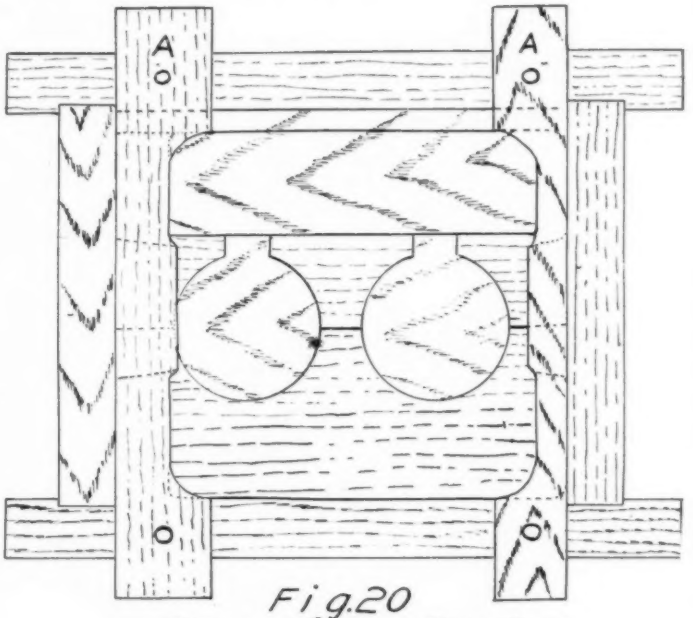


Fig. 20
Plan of the Corebox

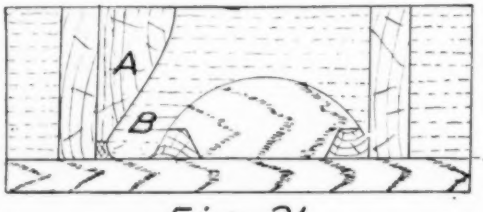


Fig. 21
Cross Section of Box BB, Fig. 5

Fig. 22

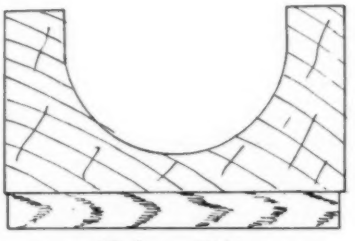


Fig. 23

FIG. 18—CORING OF THE BODY FIG. 19—SECTION OF THE COREBOX FIG. 20—PLAN OF THE COREBOX FIG. 21—CROSS SECTION OF BOX FOR *BB*, FIG. 5 FIGS. 22 AND 23—TWO DIFFERENT METHODS OF MAKING THE BEARING CORES

main pattern block and the custom of tongueing parts together is a wise one. It may be necessary to put in occasional cheek screws but they should be as few as possible.

Before assembling proper, each the flange, and although wires may be used and have the advantage that they are easily withdrawn and replaced, screws are more satisfactory all things considered, as screws will hold the facing properly in its position. Figs. clear when we discuss the molding of the pattern. D is an end print for the bearing core, although this is not really necessary. However, when such a print is used on the end of a bearing, instead of the facing print being

carried out with the end print resting on it, the facing print should be flushed with the pattern and the end prints carried to the face of the other print. This prevents the possibility of the mold being torn by a slightly projecting edge. Fig. 17 shows how the flange binds the block *BB* to the main body, while Fig. 16 is a plan of the pattern.

It is suggested that prints should be made for the square cores in order that they may be carried in the cope, but all the other openings should be painted in to guide the molder. A foundry is not a convenient place in which to study a drawing and the average molder likes the pattern and corebox to be his drawing consequently wherever the core breaks through the metal, even if prints are not left, the core surface should be painted a different color from the rest of the pattern. It is also a good practice to indicate all loose screws by painting around them. Molders, on getting a pattern, generally make it their first business to examine it carefully, determine their joints, and ascertain the parts which will have to be loosened off. However, sometimes a loose part may be overlooked and afterwards cause trouble. This is scarcely possible if the screws are marked as suggested.

Details Are Omitted

The final operation apart from painting and varnishing is, of course, the filleting and rounding of corners, and what was said when discussing the cylinder is equally applicable here. To save confusion some of the details have been left off the finished pattern Figs. 15, 16 and 17, but attention may be directed to the gland shaped facing *A*, Fig. 16. This must be left loose, as must also the print. In such a case it is well to screw the print from under the facing so that the molder by lessening the facing will also loosen the print. A separate core must be made for this facing.

The most important of the coreboxes is that for the main core, and a decision has to be made whether this shall be in one or in two cores. In the job before us the rib on the center and the round core which penetrates this rib, constitute a difficulty, so that while it would be possible, by having loose pieces, to use one corebox, yet the coremaker would divide it into two cores for convenience in handling. It would be possible of course to make one corebox half the length of the crankcase and alter it for each core. This is satisfactory if only one or two castings are wanted but it is not economical for repetition work, and it increases the possibility of error. Fig. 18 illustrates clearly the coring of the body, the dotted lines indicating the joining of the various cores. *A* is a round core and in common with most round cores may be ignored by the patternmaker. *B* and *C* are bearing cores and it will be noted that the print for these cores is thicker than the main print to facilitate setting. This also applies to the print for *D*. The core is not round throughout its entire length because of the joining with *E* and the print at *E* should be shaped so that the core will only go in one way. For the round cores *F* and *H* which are fitted into the main core the patternmaker should make coreboxes so they will be the exact length required.

The main corebox in length and width will be the distances between the walls of metal while in height the sizes will be the overall size from the face of the main print to the top of the crankcase. The first operation is to make a frame box with a bottom, the bottom of the box corresponding to the top of the crankcase. Fig. 19 is a section of the box with a block fitted to define the shape, and a thickness set on the bottom through which the holes on the top of the crankcase can be cut. Fig. 20 is a plan of the corebox with some of the minor details left off. *AA* are the bearing-supporting ribs. It is not strictly essential that these should be set into the sides of the boxes but it is better. The bearings can be screwed to these ribs and if dowels are inserted into the box sides the coremaker, after he has rammed the core, can lift the ribs off and free the core. There are several ribs in these boxes, and where these must be loose, fillets should be cut from the solid lumber. As with the pattern the final task should be filleting, and it ought to be well done as nothing interferes with the delivery of a core from a box like sharp corners. These nearly always can be obviated. Both these boxes except in detail will be identical. The prints for the cores *AA* Fig. 4, will only be in one box, otherwise they could not be set.

Sometimes the practice is adopted of shaping all the prints in this class of work; that is, a taper of say 3/16-inch is given to each side of a print and the corebox is made to suit. This involves considerably more labor, and for the majority of cores it does not afford any great gain. It is better to give a slight taper to the print, both so that it will leave a clear impress, and that the core will enter with ease.

The corebox for the part *BB*, Fig. 5, is perhaps the most difficult after the main boxes, although there is no real difficulty in making it. As in the case of the main box an outer frame is first made. A cross section of this corebox is shown in Fig. 21, and a plan at Fig. 13. The block *A* must be withdrawn from the core and the dovetail method, as shown, is best. The side fillets are shown as made separately in Fig. 13, but this is a matter of convenience and also to obtain a strong fillet if the block is made with the grain as shown. To obtain a good fillet where this end block joins the bottom, a separate piece is made of the fillet, see *B*, Fig. 21. The other parts of the box are clearly seen in the sketches and require no explanation.

It is advisable to taper the sides of these boxes slightly as a really good finish must be obtained to ensure free delivery of the core. If the box must be loosened, leather fillets are not suitable and instead the ends of the box which are checked into the sides must be made thicker according to the radius of the fillet, and the fillet afterwards shaped from them. Some craftsmen when making small narrow framed boxes make the ends so that the end grain of the timber will show on bottom and top. The reason for this is that if the sides shrink or swell the correct depth of core is always maintained by the ends. Whatever advantage is gained in this way is lost in the width of the box. If good dry lumber is used, especially if it is mahogany or baywood, correct sizes will be preserved.

Bearing Cores Different Lengths

Figs. 22 and 23 illustrate two different methods of making the bearing cores. Fig. 22, which is an ordinary framed box with the shaped ends between which the core is swept, and without a bottom, is quite satisfactory for all large work, and a great deal of small work. When a large number of small cores have to be made it is as well to make a corebox like Fig. 23 which can be quickly cut out. The bearing cores are of different lengths and some of them is in three or four different diameters, but it is so small that it is better to carve it from solid lumber than to build it up.

Two coreboxes have to be made for the block *CC*, Fig. 3, one of them being for what is really a lightening core which beds into a print screwed on the face of the main flange. Fig. 10 is a cross section of this box which is quite simple as is also the box for the coring of the outside of the block.

Several other boxes must be made, such as the one for the tail print, *M*, Fig. 3, but they are easy to make and could be given to an apprentice.

Correcting Flaws in Metals and Mixes

Problems of the Gray-Iron, Malleable and Steel Foundry Discussed
By H. E. Diller

Makes Anvils from an All-Scrap Charge

Question—Could we make cast-iron anvils of the type which have a chilled surface from a mixture of 50 per cent cast iron scrap and 50 per cent steel scrap with the addition of a little ferrosilicon? We have experimented making the anvils with an all-scrap charge but find the iron becomes sluggish and sets too quickly.

Answer—A mixture of 50 per cent cast scrap and 50 per cent steel scrap will give you an iron which will tend to set quickly because it will contain a comparatively low amount of total carbon and the high percentage of steel scrap may cause it to be oxidized in being melted. We would recommend that you cut your steel scrap to 30 per cent and see that you have enough coke on the bed and between the charges to prevent oxidation. You may not need to use any ferrosilicon but a small amount of spiegeleisen added in the cupola will be of benefit to the melt. In case the mixture does not give you a deep enough chill, you will have to secure a scrap with lower silicon and vice versa, if the chill is too deep ferrosilicon will have to be added. A 10-per cent ferrosilicon add with the charge will give good results.

Height for Charging Doors

Question—We have under consideration the building of a new foundry. We are interested in the standard height of the charging door above the base plate for a 45-inch cupola, also for a 72-inch cupola. There seems to be much confusion in the recommendation given by leading authorities and we thought THE FOUNDRY would know the most modern practice in the country.

Answer—We note that you have found that leading authorities give different recommendations in the height of the cupola between charging doors and base plates. This is because a scientific study has not actually been made by many foundrymen on this subject. You probably would get the best results in a 45-inch cupola from having your charging doors 12 to 14 feet above your bottom doors. The height of the bottom doors above the base plate would be regulated by the size of ladles you are to use. This latter would also be true of a 72-inch cupola. The charging doors on the 72-inch cupola should be 18 to 20 feet above the bottom doors of the cupola to get the best results. These heights may be change somewhat without any material disadvantage. If necessary to put the two cupolas on the same charging floor we would recommend a height of 16 feet between the charging doors and bottom plate.

Melting Medium for Malleable Iron

Question—We would like to know whether the cupola is used for making malleable iron in many jobbing foundries and whether the open-hearth or the air furnace is the cheaper for producing malleable iron when oil is to be used as the fuel.

Answer—Malleable iron is made in the cupola by manufacturers of pipe fittings, but the grade of metal is not as strong nor as ductile as that produced from the air furnace or the open-hearth. Few foundries use the open-hearth for malleable iron. The big disadvantage is that economy as secured by the open-hearth is largely dependent upon continuous operation, and this is not possible in many malleable iron foundries. Of course, the advantage of the air furnace is low first cost, as well as lower up-keep costs. The open-hearth, on intermittent production, would not be much lower in operating costs than the air furnace, which in most cases would not offset the advantages to be gained from the air furnace in lower first cost and up-keep.

Coal Is Unnecessary for the Bed in the Cupola

Question—We are using hard coal on the bed of our cupola but desire to substitute coke. A bed of 72-hour coke has been tried in our cupola several times, but did not produce hot iron. The cupola is lined to 40-inch diameter and we use 1500 pounds of metals and 180 pounds of coke to the charge. The bed is made of 1500 pounds of coal and 300 pounds of coke. How should we charge the furnace to substitute coke on the bed?

Answer—You should have no trouble in securing hot iron from your cupola when using coke on the bed. Start a wood fire and add about 800 pounds of 72-hour foundry coke. Then when a blue flame comes strong above the coke, add enough more coke to bring the level of the bed 30 inches above the tuyeres. Allow this to burn until the blue flame again comes. Then start charging the metal. Measure the time required from the start of the blast until iron begins to come. If this time is more than 10 minutes, lower the bed of coke slightly for the next heat. If iron comes in less than 8 minutes, the bed is too low. After you determine in this way the proper height of the bed, you will get hot iron if you have a good grade of coke. The coke should contain not less than 10 nor more than 12.5 per cent ash. With low ash the coke is too weak and with higher ash it does not give the heat required.

Iron Oxide Scores Lining

Question—We have occasion to melt in a 32-inch cupola lined with firebrick, a mixture consisting of 60 per cent gray-iron scrap and 40 per cent soft steel scrap. The scoring action of the charge on the lining of the cupola seems to be excessive and we would inquire to know of a better material to use for a lining.

Answer—Firebrick is used almost universally for this purpose and if you do not secure good results by using firebrick for your cupola, it is either because your firebrick is of a poor quality or your melting practice is wrong.

A mixture of 60 per cent gray-iron scrap and 40 per cent soft steel scrap is likely to be oxidized in melting, forming an excessive amount of iron oxides which will attack the lining of the cupola. To prevent this, we would suggest that you make certain you have enough coke on the bed and between the charges. It would also help if you would pile the metal toward the center of the cupola and fill up the edges with coke. One foundry we have seen melting iron puts the coke entirely around the edges and obtains good results.

Applies Metallography to Iron-II

Size of Graphite Grains Governed by Size of Sections—Open Grain Due to Several Causes—Hard Iron Caused by Free Cementite—Metallurgical Control of Cupola Considered

BY J. W. BOLTON

THE greatest difficulty in the production of an *ideal* metal mixture for heavy machine tool castings lies in the fact that the designs call for great differences in section size, even in the same piece. Obviously, it is harder to get a mixture satisfactory for both a 1-inch section and a 5-inch section than to get a good mixture for say ¾-inch to 1½-inch sections.

It is essential that the castings be strong and sound. While there are some places where weight may be the primary consideration, many castings must stand severe service. Any improvements in cutting tools will make it necessary either to make bigger, heavier machines or use better metal in the same size machine. Blowholes or other hidden defects are dangerous. The majority of such troubles are often traceable to the molding. However, in shops without close metallurgical control many defects of this nature are due to faulty composition, mixing or melting of the metal.

Rigidity is another essential. A machine tool part must not warp or twist. Most machine-tool castings require considerable machining. The metal must be soft enough to take heavy cuts and tough enough not to tear up under the tool. In many shops little attention is paid to feeds and speeds. In these places a metal might be rather hard and escape unnoticed. In a shop where the machines are run more nearly capacity such metal would cause complaint.

Close Grain Wanted

Buyers pay much attention to the appearance of the product. Open grain is commonly associated with weakness and unsoundness. Therefore, the metal must be finished with a good close grain or there will be complaints. However, open grain really does not necessarily mean weakness as is shown later where discussing size.

The foregoing considerations show that the ideal metal must

Be strong, yet neither very brittle or very ductile;

Be close grained, yet easy to machine;

Be as nearly as possible uniform in the large and small sections;

Be produced economically;

Be reliable, and the process itself must be subjected to close metallurgical control.

Through operation, the foundryman and metallurgist have discovered many valuable facts. From the knowledge of what can and cannot be done, better and more uniform metal has resulted. The ground has been barely scratched and the possibilities for further improvements are great. It is by the cooperation of all men in the industry that the obstacles to greatest success in

FIG. 9

FIG. 11

Micrographs of Gray Iron Samples

Figs. 9 *to* 12 *indicate the relation of graphite size to size of section — Fig.* 9 *was cast* 3/8 *inch thick; Fig* 10, 1 *inch thick; Fig.* 11, 2 *inches thick; and Fig.* 12, 4 *inches thick—All bars were of the same composition and poured at the same temperature—Composition; silicon,* 1.75 *per cent; sulphur,* 0.10 *per cent; phosphorus,* 0.70 *per cent; manganese,* 0.60 *per cent—Note the graphite in the* 2*-inch section is heavy and the metal in the* 4*-inch section is spongy—All unetched—x* 44 *dia.*

FIG. 10

FIG. 12

FIG. 13

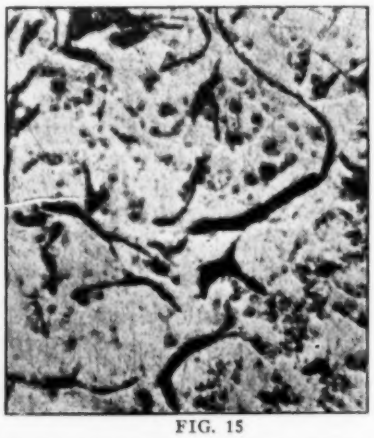


FIG. 15

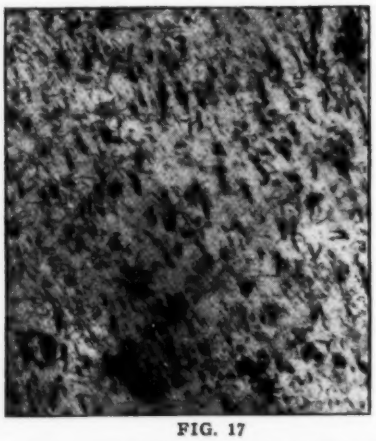


FIG. 17

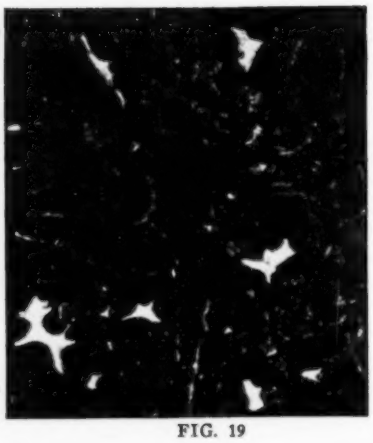


FIG. 19

Micrographs of Gray Iron Samples

Fig. 13—*Showing tendency of graphite to radiate from unmarked centers—Too much of this bunching in large patches is not good for the metal as it causes segregation—By increasing the number of nuclei it is possible to decrease the graphite size—Sulphur seems to possess this property—Unetched—x* 65 *dia.*

Fig. 14—*Coarse straight grain graphite characteristic of large castings cooled quickly—This causes open grain—Unetched—x* 65 *dia.*

Fig. 15.—*Micrograph taken from a different part of the same specimen as Fig.* 14—*Note the curved plates of graphite—The metal was made from a mixture of* 50 *per cent commercial scrap iron and* 50 *per cent coke pig iron—Unetched—x* 65 *dia.*

Fig. 16—*Striated graphite is found where the sand has partly burned into the casting and in chilled spots—The part without graphite is extremely hard—This sample was taken* 1/32 *inch under the surface of a large casting—See Fig.* 22—*Unetched—x* 65 *dia.*

Fig. 17—*Finely divided graphite is promoted by high silicon and quick cooling—This micrograph is from the edge of a* 3/8-*inch section—Contrast with Fig.* 14 *—Unetched—x* 65 *dia.*

Fig. 18—*The tendency of some steadite to form grain boundaries to pearlite kernels is indicated—The micrograph is from the edge of a* 1-*inch section—Etched with picric acid—x* 44 *dia.*

Fig. 19—*From the center of a* 4-*inch bar of approximately the same composition as Fig.* 7 *except that it contains* 0.55 *per cent combined carbon—Turned to* 1-*inch diameter this bar showed a tensile strength of* 16,700 *pounds per square inch —Etched with picric acid—x* 65 *dia.*

Fig. 20—*Pearlitic cementite decomposed by slow cooling into ferrite—This sample is the same metal as is shown in Fig.* 18, *but it was cast into a* 2-*inch section—Etched with picric acid—x* 44 *dia.*

FIG. 14

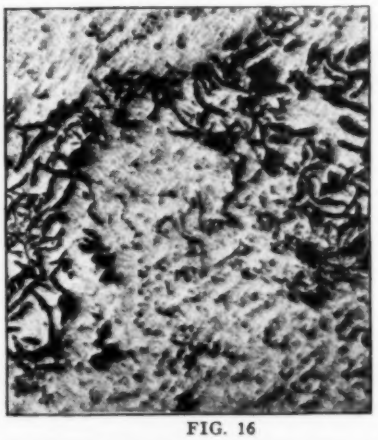


FIG. 16

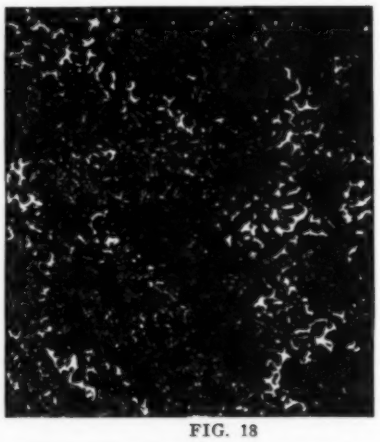


FIG. 18

FIG. 20

gray iron manufacture will be overcome.

An ideal structure to fit every case cannot be specified. A metal rather high in pearlite, with small well distributed graphite flakes and enough manganese to form rounded particles of MnS with the sulphur, instead of much of the embrittling FeS; and the steadite distributed so that it does not form an intercrystalline network, is adapted for our general run of castings.

Causes for Open Grain

Open grained metal may be defined as metal with rough pitted finished surfaces. Several causes exist for open grain. These may be grouped roughly as structural and mechanical. All foundrymen are familiar with coarse-fracture soft irons. Most of these show structural open grain. This inherent open grain is caused by one or more of the following:

Coarse graphite (Fig. 14)
Too soft matrix (Fig. 21)
Presence of steadite, and possibly ferrite, in the form of grain boundaries around pearlite kernels (Figs. 18 and 23)
Internal shrinkage

The author has under way an investigation of grain size, especially as it is affected, by section size. The following is a general indication of the results arrived at.

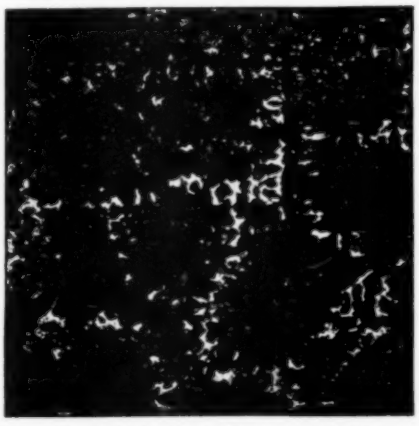
The probable major factor controlling graphite flake size is the rate of cooling, or section size, as indicated by Figs. 9, 10, 11 and 12. The minor factors are composition and pouring temperature. Within the rather narrow limits worked in, sulphur tended to lower graphite size. A slight lowering of carbon as in semisteel did not produce marked changes. Lowering silicon did not help greatly. This leaves out the direct effects obtained by increasing or stabilizing the pearlite.

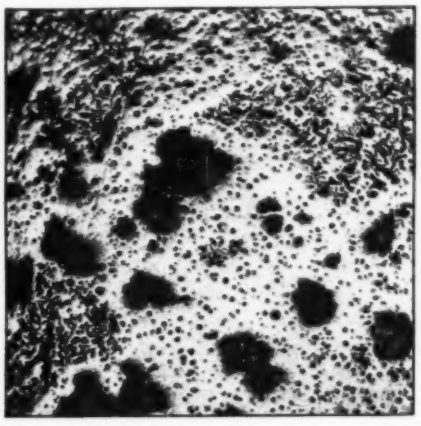
Johnson has shown that in highly oxidized iron the graphite separates in rounded particles somewhat like the free carbon in malleableized cast iron. Some investigators claim that charcoal irons produce a hooked structure somewhat like that shown in Fig. 15. This structure is seen in some irons without any charcoal iron in the mixture, or even in the same specimen in which straight flaked graphite occurs. Experiments are under way to determine whether the orientation of the flakes cannot be changed during formation by use of a magnetic field. If the flakes could be made parallel the metal would be strengthened in one direction at the expense of the other. The solution of the graphite question probably lies in stabilizing the pearlite. Increasing the nucleii number, or centers of crystallization would also have the effect of making smaller graphite.

A matrix high in ferrite cannot stand heavy machining without tearing. The major causes of soft matrix are improper composition and wrong pouring temperature. Heavy sections tend to make a weak matrix. The effect of composition is shown in Figs. 18 and 20, and in Fig. 2 of the article published in the previous issue of THE FOUNDRY. The sample shown in Figs. 18 and 20 contain around 1.75 per cent silicon. Fig. 2 shows an iron of 1.20 per cent silicon. Up to the 1-inch section the 1.75 per cent silicon metal finished well as indicated in Fig. 18. At 2 inches it is soft and weak, as shown in Fig. 20. A 4-inch square section of this composition averaged about 0.15 per cent combined carbon and was very open. All these samples were poured at the same temperature. The low silicon iron of Fig 2 was almost the same in structure in both the 1-inch and 2-inch section.

The effect of pouring temperature in Figs. 7 and 20. Both specimens came from the same relative place in the same sized section. The analyses are almost identical. The size of the graphite flakes is about the same, but this does not show well in the etched micrographs. The only difference was the pouring temperature. In this case it meant 50 per cent difference in strength. This indicates how the structures and strengths are related.

The presence of steadite, in the form of grain boundaries to the pearlite grains, as shown in Figs. 18 and 21, is a probable cause of some tearing out by heavy feeds. It is reasonable to suppose that this brittle structural component when distributed in this manner forms many of the planes of cleavage when the metal is fractured.





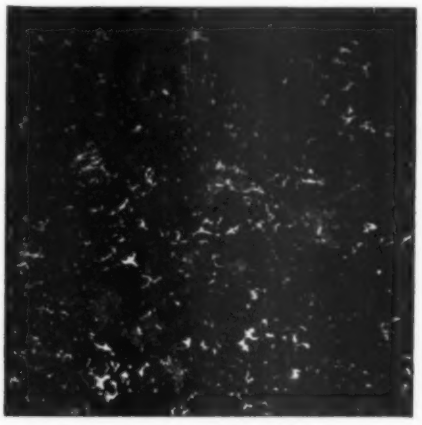


FIG. 21—THE LIGHT GRAY ROUNDED SPOTS INDICATE WHERE GRAPHITE "WHORLS" WERE, SUCH AS ARE SHOWN IN FIG. 13—THIS SAME EFFECT, BUT LESS PRONOUNCED IS SHOWN IN FIG. 18—ETCHED WITH PICRIC ACID—X 65 DIA. FIG. 22—BURNED-IN SPOT ON CASTING, 1/32 INCH FROM THE OUTSIDE—GRAPHITE OCCURS IN STRIATIONS—SOME OF THE SMALL DOTS ARE LITTLE PITS AND THE REST CONTAIN OXIDES OR SAND—THE BIG DARK SPOTS ARE MOSTLY SAND—UNETCHED—X 25 DIA. FIG. 23—SAME METAL AS IS SHOWN IN FIGS. 18 AND 20, BUT FROM THE CENTER OF A 1-INCH SECTION—NOTE THE STEADITE BOUNDING AND THE LARGE SIZE OF THE PEARLITE KERNELS—ETCHED WITH PICRIC ACID—X 44 DIA.

Shrink Spots Due to Design

Internal shrinkage often causes an open grain appearance. A shrink hole can be distinguished from a blow hole by its rough crystalline appearance. If open grain or sponginess shows only in spots, internal shrinkage may be the cause, the small shrink holes giving the open grain appearance. The primary cause of most shrink spots is improper design. Where changes in section size are abrupt the pull of the feeding metal is localized. This results in a large drain from a relatively small volume and consequent shrink holes. Even if no holes result it is probable that a condition of stress is there, giving weak and unreliable metal. The remedy for most internal shrinkage is more equal distribution of metal, better feeding, and

often a change in composition. Only in extreme cases is it necessary to use chills on the heavy section. Graphite is lighter than iron and by increasing the graphite the metal will not contract so much.

In machining cast iron the tool literally pushes the metal off ahead of it. In steel there is a shear line just ahead of the tool. In neither case is the tool actually against the newest cut. The probable reason that gray iron machines as it does lies in the fact that the metal is broken into separate grains by the graphite flakes, and possibly the steadite grain structure.

Heavy feeds tend to pull out the metal grains below the line on which the tool operates. A soft or a brittle metal will *pull out* leaving the appearance of open grain. This sore of open grain can be overcome by taking more finishing cuts. Open grain due to the falling out of graphite flakes cannot be closed entirely even by grinding. Of course, the real economic remedy lies in getting metal which will cut as easy yet not pull out. If the tool is set wrong, the resultant lines of stress set up on the surface being machined are such that the metal grains are stressed along their weak cleavage planes resulting in pulling out the grains. Some other causes of open grain appearance are warped casting, thin cut in one place and deep in another, and round piece set off center.

Really and uniformly hard iron is found when there is more than enough combined carbon present to form the maximum of pearlite. This results in separation of free cementite in place of free ferrite. Free cementite is extremely hard, being a major constituent of white cast iron. As ferrite decreases and pearlite increases, the iron increases rapidly in strength and somewhat in hardness up to the pearlite maximum; around 95 per cent pearlite, or 0.80 per cent combined carbon. Any increase in combined carbon forms free cementite with great increase in hardness and some decrease in strength in the matrix. The remedy for such hardness is to raise the silicon. It should be noted that, within limits, the lower the total carbon the more silicon needed to lower the combined carbon a specified amount. This applies especially to semisteel.

The kinds of hard spots most commonly met with are sulphur spots, phosphorus spots, chill spots and burned-in spots. Sulphur spots, some of which are shown in Fig. 8, of the article appearing in the previous issue of THE FOUNDRY, are segregations rich in manganese sulphide (MnS). They are somtimes caused by letting the iron stay too long in the ladle, the MnS rising to the top. They cause little trouble in properly mixed iron. Sometimes segregations are found rich in phosphorus, which are very hard and have a peculiar shiny appearance, in certain lights, on the machine surface. The trouble generally lies in the mixing. Chill spots are high in combined carbon caused by chilling in wet spots in molds and similar bad practice. Fig. 22 shows burned-in casting surfaces, commonly caused by wrong sand or poor blacking. Such surfaces are intensely hard, even to a depth of 1/16-inch. This trouble is easily avoided with proper care.

The ideal process is one which lends itself perfectly to scientific control. Some of the inherent faults with the cupola process are:

Temperature cannot be controlled closely:

The percentage of total carbon cannot be regulated:

Cannot melt without some gain in sulphur.

It does not seem possible to raise the temperature of the melted iron above 2700 degrees Fahr. with the regular cupola process. When the metal is melted its temperature cannot be raised at will. If dull metal results from any cause, it is necessary to pour the castings wrong or pour the iron into pigs—the metal cannot be put back into the cupola. Temperature control is a strong feature of the electric furnace and the air furnace process.

Additions of steel to the charge in the cupola lower the total carbon somewhat but do not allow close control. In the practice of many foundries steel additions have little effect on the total carbon and our experience is that in no case is the effect strictly quantitative.

Good slagging helps the sulphur problem in the cupola but is not a final solution. Slags are more effective at higher temperatures. Slagging is worth while in any case but other processes are better adapted to effective slagging than is the cupola process.

Close metallurgical control is absolutely necessary to the greatest success in gray-iron work. Most good foundrymen are practical metallurgists and it pays the metallurgist to co-operate closely with his foundrymen. Testing methods must be accurate and as complete as possible. Intermittent testing is about worthless. It is the day to day work that counts. Steady persistent application is necessary. Metallic microscopy is one of the most valuable testing methods we have, being especially valuable for investigating special cases of interest.

How and Why in Brass Founding

By Charles Vickers

Want Small Ingots for Getting Weights

We would like to learn whether pig metals, such as copper, tin, lead and zinc, can be remelted and molded into smaller ingots for convenience in getting our weights? If this can be done, how should we proceed, and will there be an excessive loss of metal in the operation?

Tin, lead and zinc can be run down into smaller and more convenient ingots, only it is not the practice to remelt zinc, because the metal comes in flat slabs, which are easily broken into small pieces. If it is desirable to remelt the zinc, it can be done, but the temperature should be kept below the point where it begins to smoke strongly, giving off white fumes; otherwise, the loss will be large, because the zinc is distilled into the air, and immediately is oxidized. Keep the temperature down, and scatter on the surface of the zinc, a little sal ammoniac, then pour it into ingots. Both tin and lead are easy to melt, and the loss should be trifling. They can be melted in crucibles. First melt about a half a pot full of metal, then pull it from the furnace, and fill it with cold metal as it will melt in the bath already formed. In this way the lead and tin are not overheated, for after the crucible is removed, it will be red hot at the bottom and up the sides a short distance and this heat soaks into the melted tin and lead, and can be utilized to melt more metal. Both tin and lead can be run into small ingots, or either metal, or both can be poured onto the

floor into little pan cakes of varying size, which are very convenient to make weights. The copper should not be remelted as it will absorb oxygen. Sheet and heavy wire scrap copper be used to make weights.

White Metal Alloys for Pattern Plates

We would be greatly obliged for any information you may be able to render relative to white alloys suitable for the casting of pattern-plates and also of duplicate patterns. We are particularly interested in any formulas for such alloys that has been published by you.

Where cheapness is a consideration the following alloy is used for duplicate patterns:

CHEAP PATTERN ALLOY

	Per cent
Lead	75
Tin	15
Antimony	10

Where cheapness is not a consideration the following alloy is used:

WHITE METAL ALLOY

	Per cent
Lead	50
Tin	40
Antimony	10

A formula that is probably more frequently used than either of the two given is the following:

WHITE METAL ALLOY

	Per cent
Zinc	50
Tin	50

Frequently the zinc-tin alloy is improved by the addition of 1 or 2 per cent bismuth in place of that amount of tin. Antimony frequently is substituted for bismuth in the interest of economy. This alloy is remarkably free from shrinkage.

Pattern plates most frequently are cast of aluminum alloys and any good casting aluminum alloy may be used. Antimony sometimes is added from force of habit, due to its use in the leaded alloys. It is supposed to control the shrinkage of the aluminum alloy, but does not, as silicon is the only element that will control the shrinkage of aluminum.

Oxidized Metal Is Cause of Honeycombed Castings

We are having trouble with brass castings which when turned are honeycombed and the holes are filled with a greenish dust. The castings are small half bushings which are cast bearing up.

The difficulty is due to oxidation. The metal is oxidized in the furnace while being melted, and is being poured into the molds too cool, when it oxidizes again. The remedy is to either use charcoal, or blocks of hardwood, on the metal in the furnace. When filling the crucibles, as the charges heat poke them down under the charcoal, before adding more cold metal. Keep the temperature of the metal low until the pot is filled, then allow the furnace to heat strongly.

Five minutes before pulling the pots add 3 ounces of phosphor copper to each pot of 100 pounds of bronze. Pour the metal while the zinc smokes freely. Do not allow it to become dull and sluggish. Caution the molders against ramming the sand over the patterns in the drag too hard, also have the sand of the same degree of dampness as used for iron.

Selecting the Best Sand and Core Binder

We would like to know what is the best core-sand mixture for brass plumbing goods, and what are the best oils or compounds to use for binders.

There are so many good sands and so many excellent binders that it is impossible to say which is the best. However, we believe, in the interests of economy, it would be advisable to select a core sand from your own vicinity. To make this selection to the best advantage get a sample of Providence river sand for cores. Any sharp sand that approaches this sand for small brass work, can be classed as being good. Some makers of plumbers' brass goods prefer a core oil as binder, others want something like the dextrin products and a few others swear by rosin. A core composed of dry white sand, 30 ounces; dry molding sand, 10 ounces; powdered rosin, 2 ounces, baked until the rosin melts, makes a good, strong core.

When selecting the best core binder, naturally it is necessary to test all binders, and the advertising pages of THE FOUNDRY will afford the required addresses. These manufacturers will be glad to co-operate in the selection of best binder and best core mixture.

Melting Alloys of Lead

We desire to make large quantities of castings of an alloy having the following composition: Lead, 74 per cent; nickel, 6 per cent; copper 20 per cent. We use noncrucible furnaces for melting in the case of ordinary brass and bronze and we would like to learn what difficulties we will be likely to encounter with the lead alloy in the same furnaces, and how we can overcome them.

The experience of others has been that alloys containing large percentages of lead cannot be made successfully in noncrucible furnaces fitted with ordinary linings. The difficulties that will beset the adventurer who attempts to make alloys containing over 40 per cent of lead in noncrucible furnaces can be overcome, or rather will be sidestepped by simply using furnaces that require crucibles. In other words do not attempt to make this alloy in the noncrucible furnaces, but make it in crucibles. A large output can be obtained by simply using large crucibles.

Alloy for Aluminum Match Plate Castings

We are making aluminum mach plates using the following alloy: Aluminum, 80 per cent; zinc, 20 per cent. We have difficulty getting them smooth, that is the metal is honey-combed in some places, more so in the drag, while the cope side has a nice appearance. Can you tell us the cause of this peculiarity?

The easiest way to solve this problem is to change the alloy that is being used. Use the following alloy:

ALUMINUM MATCH PLATE ALLOY

	Per cent
Copper	3.00
Zinc	15.00
Aluminum	82.00

This alloy will run better and be free from the crystallization that causes the "honeycombing" in the drag half of the mold.

Pin Holes Are Found in Aluminum Castings

What mixture of aluminum should be used for trimmings on the sporting body of an automobile? The castings must have a high polish. We are using pure aluminum which we obtain from a factory making kitchen utensils. The aluminum is in the shape of clippings, and we melt it in a kerosene-fired tilting furnace, using chloride of zinc as a flux. The castings, which weigh about 3 pounds each, always contain little pin holes.

An alloy of aluminum, 92 per cent, and copper, 8 per cent, is suitable for automobile trimmings. First make a hardener by melting any given amount of copper, and adding an equal weight of aluminum. Make the alloy by melting together 16 pounds of the hardener and 84 pounds of scrap aluminum.

If the castings are filled with small holes, the remedy is to pour the aluminum cooler than has been the practice. If the castings are of heavy section, pour them when the aluminum shows a very faint shade of red, in the shadow. There is no deoxidizing alloy that can be added to aluminum to prevent these holes; it is all a question of pouring temperature.

Some aluminum foundrymen believe the addition of 10 per cent of tin to the alloy prevents this trouble, and you might try this in case lowering the temperature at which the molds are poured fails.

FIG. 1—THE PATTERN FOR THE ENGINE FRAME IS SUSPENDED FROM CAST IRON BINDERS

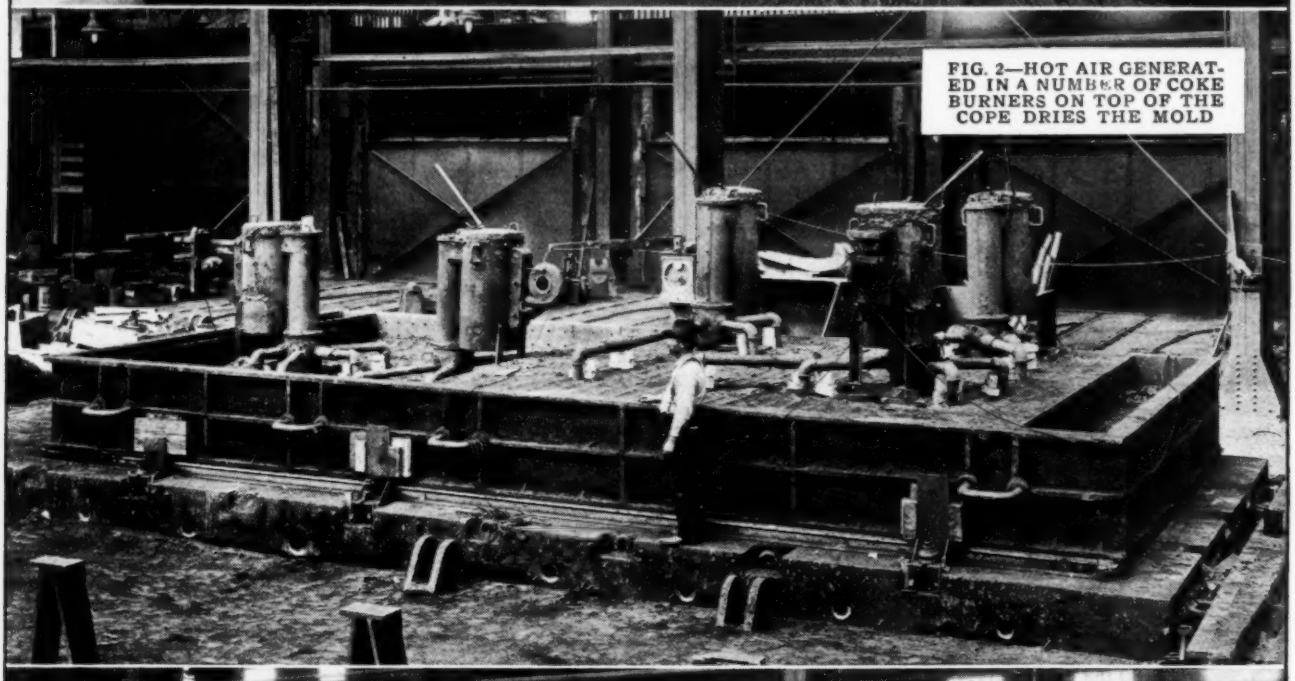


FIG. 2—HOT AIR GENERATED IN A NUMBER OF COKE BURNERS ON TOP OF THE COPE DRIES THE MOLD

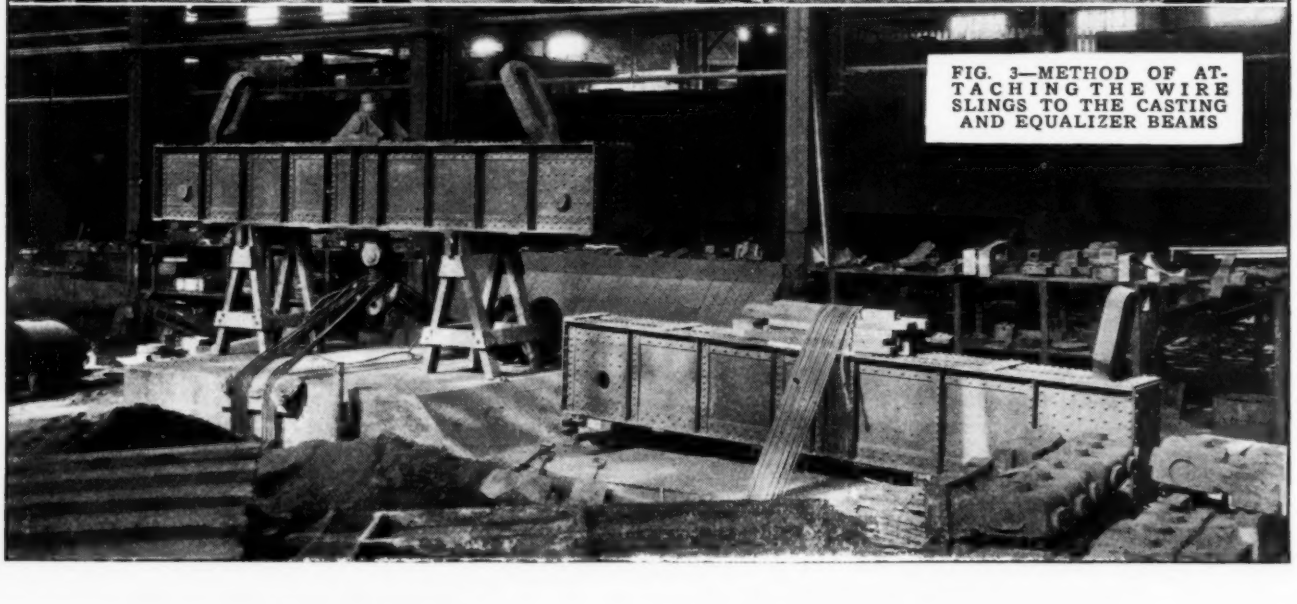


FIG. 3—METHOD OF ATTACHING THE WIRE SLINGS TO THE CASTING AND EQUALIZER BEAMS

How Large Engine Parts Are Made-II

In Addition to the Many and Varied Problems Involved in the Actual Molding and Pouring of the Castings There Remains the Problem of Handling Them After They Are Made

BY PAT DWYER

STRENGTH and accuracy are the two main features kept in view in the manufacture of large gas engine castings. To that end they are made in dry sand or loam molds which withstand the pressure of the molten iron and produce castings that are perfect replicas of the patterns less the natural shrinkage. Cores are employed extensively, some to form parts of the outer walls of the molds and others to form water chambers on the interior. In either case they are so designed that a practically uniform thickness of metal is maintained all over the casting. The frame, front cylinder, tie piece, back cylinder, and tail guide are arranged in the order named, aligned by recessed fits and bolted together to form a rigid unit capable of transmitting within itself the entire working stresses of the engine. The frame is firmly anchored to the foundations while the tie piece and tail guide are bolted to heavy foundation plates in such a way as to provide for longitudinal movement due to expansion and contraction of the cylinders, an arrangement that prevents working stresses from being transmitted to the foundations. The weight of the pistons and piston rods is carried by crossheads traveling on guides formed in the frame, tie piece and tail guide, thus relieving the cylinder bore of all wear except that due to the piston rings. In addition a renewable liner made from a special, hard, fine-grained iron is used for the working bore. The liner is held in the cylinder described in a previous article by a patented locking device in the center and also by a shrink fit throughout its entire length.

The engine frames, which are made either right or left hand depending on which side the crankshaft opening is located, are the open-top type cast in one piece in an inverted position to that which they will occupy when in use. This is illustrated in Fig. 4 which shows one of the large frames which has just been lifted out of the mold. The frame rests its entire length and width on the foundation, thus insuring an unusually large bearing surface. Substantial reinforcement under and around the main bearing jaws and two heavy, steel tie bolts, extending across them at the top are provided to prevent the jaws from spreading. These features are shown to better advantage in Fig. 5.

To secure accurate alignment, the end of the frame is recessed to receive the turned end of the front cylinder. The end core in the frame casting forms a heavy, double internal flange for this purpose. The double flange is reinforced further by a number of closely spaced connecting ribs. The slide for the main crosshead is cast integral with the frame. Guide plates cast separately extend over the crosshead shoe and are bolted and doweled to the slide. They take any slight lift of the crosshead due to the throw of the connecting rod.

Pattern in Two Parts

The pattern for the engine frame 30 feet x 11 feet in width as shown in Fig. 1 was made in two parts to facilitate handling. Apart from its size and bulk it was a comparatively simple pattern to construct. The interior of the casting was formed entirely in dry sand cores and therefore the pattern resolved itself into a plain frame conforming to the outside shape of the casting and boarded in top, bottom and sides. The block and core print used to form the crankshaft bearing was detachable. It was used twice on one side to make the two right hand frames and then twice on the other side to make the two left hand frames. One set of coreboxes served for either right or left hand frames.

Although these engines are the largest made to date, the frames were within the capacity of the two concrete pits 34 feet x 15 feet x 10 feet in which the Allis-Chalmers Co. has been making large engine frames for several years. The pits were used alternately, thus when the pattern had been drawn out of one pit it was placed in the other. By the time the first mold had been dired, cored, assembled, poured and allowed to cool, the second mold was in shape to have the pattern withdrawn and returned to the first pit.

The top edge of the concrete wall surrounding the molding pit is covered with a number of wide angle-iron strips. These strips are attached permanently to the wall and having been carefully adjusted level and parallel have served ever since as accurate guide lines whereby to set the patterns. By referring to the illustration Fig. 1, it will be noted that the pattern hangs suspended from a number of long binder bars which serve the double purpose of holding it up and holding it down. The usual method of supporting large patterns bedded in the floor is to build up piers at various points under them and then adjust the pattern by wedges on top of the piers. After a sufficient quantity of sand has been rammed under the pattern to support the weight, the wedges are withdrawn and the cavities filled with sand. Occasionally they are allowed to remain in the mold until after the pattern has been removed. They then are taken out and the impressions filled with sand and slicked over during the process of finishing the mold. Packing the sand under the pattern will shift it out of place if it is not held down by suitable weights.

In many instances the weights are placed directly on the pattern after it has been wedged and blocked into the required position, but sometimes the ends of the weights rest on supports clear of the pit and in those cases wedges are driven between the upper surface of the pattern and the lower surface of the weight. If the weights are not long enough to span the pit, sections of railroad rails are set on and the weights placed on the rails.

The method illustrated in Fig. 1 is an improvement on the foregoing. Sand is rammed all over the bottom of the pit until it has reached a point within a few inches of where the pattern eventually will rest. A permanent coke bed, only renewed at long intervals and not disturbed each time a casting is lifted out, remains on the bottom of the pit. Suitable pipes located at the four corners of the pit serve to discharge the gas and steam generated during the drying of the mold and also during pouring. Vent holes are provided at 3-foot intervals all around the pit at the floor line. These holes which show quite dis-

tinctly in Fig. 2 extend through the concrete wall and also through the steel plate with which the top of the wall is reinforced and furnish a ready means of escape for the gas generated at any point in the mold.

The pattern is allowed to rest on the temporary bed while the long binders, provided with slots in the center, are lowered into place with the ends resting on opposite sides of the pit. The slots in the binders are placed directly above corresponding holes in the pattern. Long bolts, threaded at both ends are inserted in the slots and pushed down through the holes in the pattern until the lower ends engage tapped and threaded holes in a number of square plates attached to the bottom of the pattern for that purpose. A nut and washer on the upper end of each bolt, where it projects above the binder, serve to adjust the pattern.

The lower surfaces of the binders while approximately forming a plane are not sufficiently accurate to serve as a guide while setting the pattern. For that reason the ends of the binders are placed on blocks and a straight edge is employed to bring the top surface of the pattern in line with the edge of the pit. The pattern hangs suspended from the crane in approximately the proper position until the bolts have been tightened tentatively. Further adjustment is effected by slacking or taking up individual bolts and by driving a number of wedges between the top surface of the pattern and the lower edges of the binder bars. When the pattern finally is adjusted it hangs suspended rigid and firm from these binder bars and in its proper relative position in the pit. For further precaution, wooden braces, two of which may be seen between the pattern and the end of the pit, are jammed between the pattern and the side and end walls of pit. The binders are not removed until after the sand has been rammed firmly under the pattern and up around the sides and ends to height sufficient to insure the pattern from shifting out of position under subsequent ramming.

The pile of short rods, shown in the foreground of Fig. 1 are employed for reinforcing the side walls of the mold. This is in accordance with standard foundry practice on heavy work, whether the mold is made in green or dry sand. In addition to placing rods to support the corners, a row of rods is laid surrounding the pattern on top of each course of sand as the ramming progresses. The facing sand employed on this casting and for that matter on all the heavy castings made in the shop is prepared by mixing a natural loam sand found in the vicinity in the proportion of half new sand and half old sand. After passing through a grinding pan and being riddled, it is ready for use.

Rods laid vertically and horizontally are employed to support the body of sand forming the interior of the mold, that is the part between the two sides of the frame. The housing

FIG. 4—THREE CRANES, TWO OF 60 TONS EACH AND ONE OF 40 TONS RATED CAPACITY, WERE EMPLOYED TO CARRY THE CASTING FROM THE CASTING PIT TO THE CLEANING FLOOR

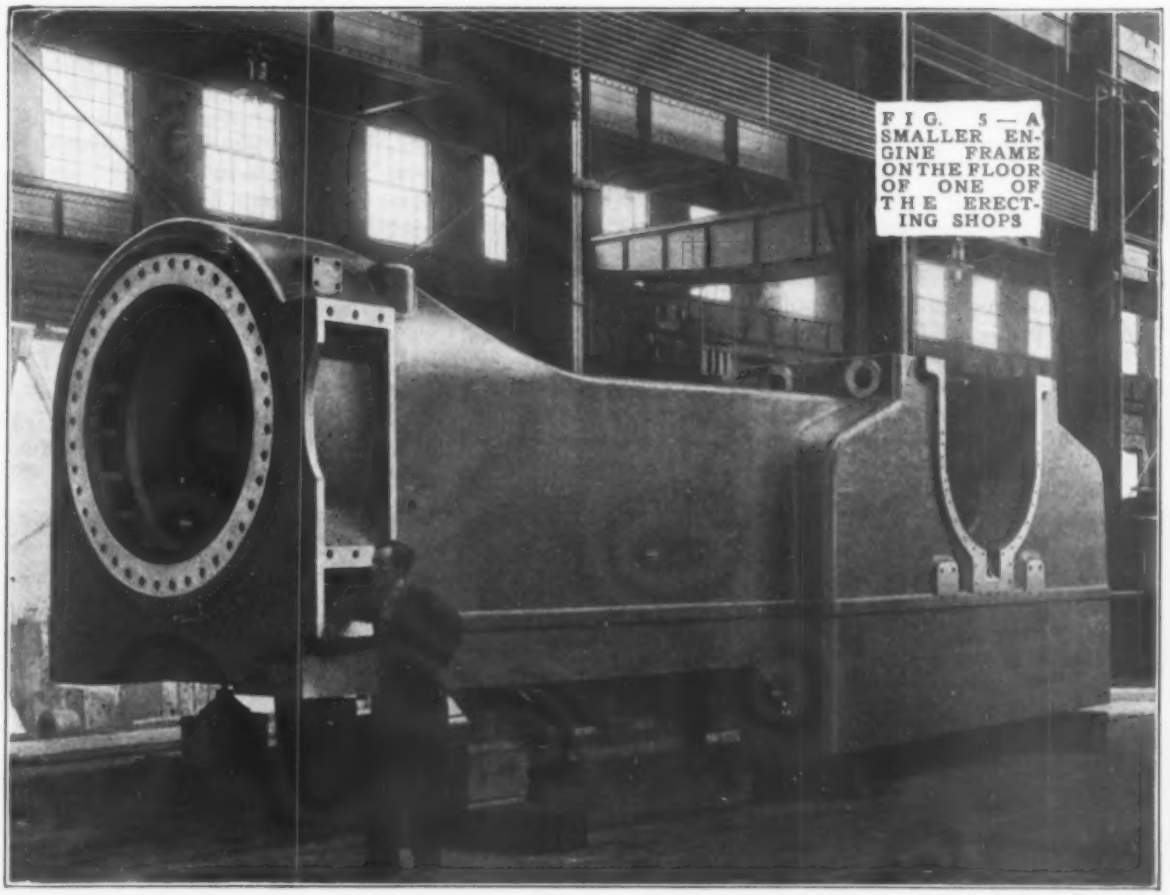


FIG. 5 — A SMALLER ENGINE FRAME ON THE FLOOR OF ONE OF THE ERECTING SHOPS

immediately in front of the cylinder is formed by a dry sand core, but the remainder of the open space is formed in the mold by the pattern. Auxiliary coke beds in the large body of sand serve as a factor in drying the mold and also provide an avenue of escape for the large volume of gas generated when the mold is opened. The method of pouring this casting is indicated in Fig. 4. In addition to the gates shown at the right hand end and the gate shown on the joint line near the center, two gates were placed at the left hand end. The iron was poured simultaneously from three ladles. Cores were employed to form the entire gate openings in the sand, with the exception of the gates at the center. These were cut in the joint after the mold was finished.

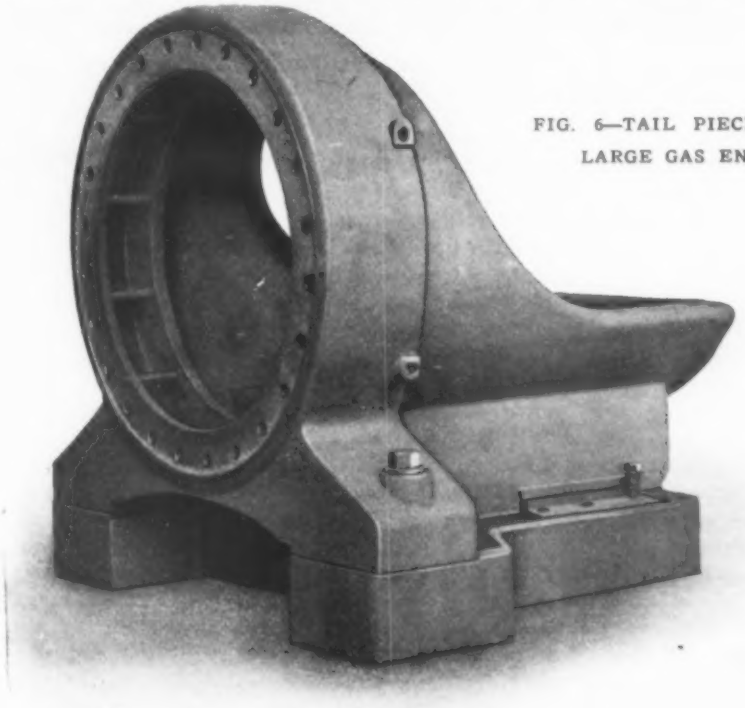


FIG. 6—TAIL PIECE FOR A LARGE GAS ENGINE

While ramming the cope, long 4-inch plugs were set at various points directly over the pattern. Later these plugs were removed and left openings through which the hot air pipes from the various heaters were introduced. Fig. 2 shows the mold after it was finished and blacked, but before the cores were set. It will be noted that the cope was supported on a number of steel rails which in turn rested on the concrete walls of the pit. Instead of providing permanent guides on this big cope, something that in all probability would get broken or twisted out of shape in a short time, the simple and easily applied guide shown in Fig. 2 has been adopted. Light iron brackets bolted to the anchor bolts support the upright guides while the slides are attached to the cope by the simple expedient of jamming them between the bottom and the intermediate flange. Each time after the cores had been set and the mold closed for the last time, the guides were removed to make room for the anchor bolts engaging the binders which held the cope down during the pouring operation.

The method for drying the mold shown in Fig. 2 has been in use for several years. Each of the stoves is

made up of two chambers. The larger contains the fuels and the smaller comprises a hot air chamber which supplies a number of smaller pipes leading down through the cope and discharging hot air close to the bottom of the mold. Each stove is provided with a lid rendered air tight by the application of a few shovelfuls of mud. A small, electrically driven fan, attached to the back of each stove, furnishes air for combustion and also serves to drive the highly heated gas evolved into the mold. The heat is applied steadily for four days and nights to dry each of the large engine frames.

After the mold is finished, closed, bolted down and the runners made up it is poured from three ladles suspended from as many cranes. To employ the third crane it is necessary to build a long runner basin at one end. The iron is melted in two 72-inch cupolas and is the same character of iron used for general heavy machinery.

Provided with ample crane service and special equipment, the problem of lifting these large castings out of the mold excited no particular attention. Each casting was allowed to cool in the pit for several days and the sand was removed from both sides and under each end. Two equalizer beams were set on top of the casting as shown in Figs. 3 and 4. It will be noted that to provide a vertical lift for each of the three cranes, it was necessary to allow one end of the right hand equalizer beam project over the end of the casting a considerable distance. Twelve strands of a 1-inch wire cable were wrapped around each end of the casting. Wooden blocks were inserted between the cables and the rectangular edges of the casting to prevent the cables from chafing under the terrific strain imposed when the cranes simultaneously began hoisting. The three cranes employed on this job were made by the Pawling & Harnischfeger Co., Milwaukee, two of 60 tons lifting capacity each and the third having a lifting capacity of 40 tons. It is stated that the cranes have been in use for 16 years and the present cables have seen three years' service. The cleaned casting weighed 100 tons, but it is estimated that the entire load lifted by the cranes illustrated in Fig. 4 amounted to over 175 tons. The casting was taken by the cranes to the cleaning room which in this shop comprises a section of one end of the main bay, set apart for that purpose. It was set down, the cylinder end on the floor and the other end resting on suitable supports to maintain it in a horizontal position. Here it was chipped and also had the core forming the opening in the end as well as the body of sand forming the space between the two sides of the frame removed. It then was rolled over and after the chamber cores in the side walls had been removed, the casting was taken to the machine shop for assembly. One of these castings in an inverted position to that shown in Fig. 4 is shown in Fig. 5.

A mold partly finished for one of the fly wheels is shown in Fig. 7. It was made entirely in dry sand cores assembled at a suitable point on the floor surrounded by rammed green sand and enclosed between top and bottom plates and a horizontal sectional steel curbing. These castings are made according to the usual foundry practice on heavy fly wheels, that is the hub is made as a separate casting and the remainder of the wheel made in two halves.

The foundation plate on which the wheels are made is provided with a two-step spindle seat with centers 8 inches apart. This arrangement provides for a splitting core between the two halves of the wheel on the perimeter at opposite center points. A sand bed is rammed on the plate and swept level to form a seat for the cores. A row of flat segment cores each provided with a shoulder on each side are laid on the bed and guided into their proper position by a marker attached to the sweep arm. The arm cores then are set in their proper position, the inside shoulder on the bottom core serving to locate the outside end of the arm cores.

Segment cores set vertically on the bottom cores and with the ends fitting snugly into shoulders in the arm cores are employed to form the in-

FIG. 7—THE MOLDS FOR THE FLY WHEELS WERE MADE ENTIRELY IN DRY SAND CORES SURROUNDED BY RAMMED GREEN SAND AND ENCLOSED BETWEEN TOP AND BOTTOM PLATES AND A HORIZONTAL SECTIONAL STEEL PLATE CURBING

side face of the rim of the wheel. The space between each pair of arm cores is filled with sand and rammed solidly. A covering ring is set on top of the arm cores. This ring is provided with suitable holes for the accommodation of bolts extending from the foundation plate. These are employed to bolt the mold firmly together.

The cores forming the outside face of the mold are guided into place on the lower edge by the shoulder on the bottom cores and on the top by a marker attached to the sweep arm. After they are all set, a number of sticks and wedges are placed as braces to prevent the cores from shifting out of position as a result of ramming sand behind them. A sectional adjustable steel plate curbing is set all around the mold and at a sufficient distance back from the outside row of cores to provide a thickness of about 9 inches of green sand. Metal is introduced to the bottom of the mold through gate cores similar to the two shown at *B* in Figs 7. The cores are placed upright at the back of the outside cores and with the lower holes coinciding with similar openings in the cores forming the outside face of the wheel. Sections of straight core are built on top of the lower runner cores and brought up flush with the bottom of the pouring basins.

The outside curbing, made up of sections of ¼-inch, 6 x 2-foot steel plate is part of the regular shop rigging. A sufficient number of sections are employed to surround the mold as shown in Fig. 7. It will be noted by referring to the illustration that each end of each section is provided with three rows of ¾-inch holes spaced vertically on 4-inch centers. An additional row of holes is provided in the center of each plate. It readily will be apparent that this arrangement provides for a wide range of adjustment and also provides for the use of from one to three rows of retaining bolts to hold the different sections together. The number of bolts employed depends on the character of the mold and also on the relative position assumed by the curbing. Naturally, a row of curbing placed around the lower part of a large and deep mold will require a greater number of bolts than a similar row used around the top of the same mold or placed around a comparatively shallow mold by itself.

On account of the dust, sand and dampness of the foundry, threaded bolts soon become useless. If only out of use for a short time the moisture rusts the threads and the dust and sand cut them away. Bolts and nuts easily are lost in the sand and the supply constantly has to be renewed.

The bolts shown holding the curbing sections together in Fig. 7 are not threaded. Each is provided with a narrow slot into which a flat tapered key is driven by a few blows from a hammer. After the casting has been poured the keys are knocked out and with the bolts collected in a box ready for the next time they may be needed. In the curbing shown in Fig. 7, for a fly wheel 23 feet in diameter and weighing 75 tons, six bolts are used at each of the joints to hold the ends of the sections together.

A set of flat segment cores similar to those used on the bottom of

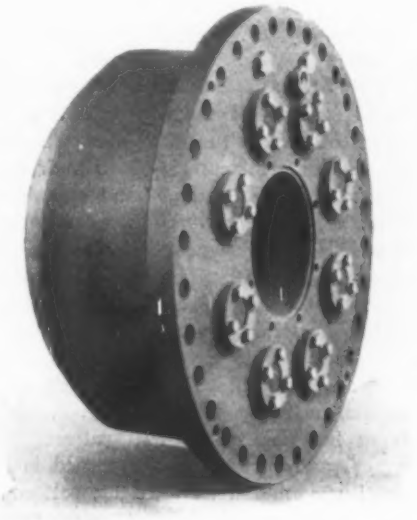


FIG. 8—THE CYLINDER HEADS ARE LARGE AND DEEP AND PROVIDED WITH CONTINUOUS WATER CHAMBERS

the mold are employed to cover the top. The shoulders on the covering cores fit snugly between the inside and the outside vertical cores and prevent the outside cores from leaning in when the sand is rammed behind them. The splitting cores, one of which may be seen at *A*, are set in prints provided for the purpose and then a covering ring is placed over all and bolted down. Openings are provided in the splitting cores so that one side of the mold does not fill before the other. These large wheels are made in halves, partly to relieve contraction strains, but principally to facilitate transportation and erection. The halves are machined and fitted together and the hubs are attached during the process of assembling the engine. Each engine made at the Allis-Chalmers plant is assembled to the last detail on the erecting floor. It afterward is taken apart and divided into as many units as are necessary for shipping. Special, all steel cars, made by the company are provided for shipping the castings too heavy for the ordinary cars provided by the railroad companies.

Limestone Is Necessary to Clean Melting

Question—Can you suggest the cause and point out a remedy for the following trouble we are having with our cupola. It is lined to 24 inches diameter and is supplied with air from an air belt 8 inches in diameter, through 3 tuyeres each 5 inches in diameter. The tuyeres are located 24 inches above the sand bottom. We generally use about 6 or 8 pounds of limestone as a flux after the second or third charge and find that after 2 tons of iron has been melted the furnace bridges across. What would be the correct charges of iron, coke and flux for a furnace of this size. Do you think our trouble can be due to lack of air supply or too little flux?

Answer—We should say offhand that your cupola bridging is due to an insufficient supply of limestone. There may be contributory features such as heavy charges of iron and not sufficient coke between the charges but 6 or 8 pounds of limestone per charge will exert no appreciable effect.

Without further details it is impossible to specify the direct cause of your trouble, but we shall indicate some of the essential features for the successful operation of a small cupola. You can check your practice against them and thus will be enabled to judge what change will be necessary.

A 24-inch cupola should melt 4500 pounds of iron an hour, and since 30,000 cubic feet of air is required to melt 2000 pounds of iron it follows that you will need to supply 67,000 cubic feet of air an hour or 1116 cubic feet a minute. In fact the blower should be capable of delivering 1500 cubic feet a minute to compensate for loss in leakage, friction, etc. A 10-inch pipe will be required to connect the fan with the wind box around the shell of the cupola. The wind box should be connected with a continuous tuyere through the lining at least 4 inches high so that the air can enter the body of fuel all around freely and in sufficient volume.

A prolific source of trouble in small cupolas is the attempt on the part of the melter to use large charges of iron. In a 24-inch cupola the iron charge should not exceed 500 pounds and where the coke is of an inferior quality the iron charge should not go over 300 pounds. In your case we should advise using 300 pounds of iron and 40 pounds of coke at first. This

proportion could be increased or modified after a day or two. The bed coke on account of your exceptionally high tuyeres (24 inches) will weigh approximately 450 pounds, but it is better to measure the height of the bed at first instead of weighing it. The bed just before charging commences should extend about 30 inches above the tuyeres. Spread a good shovel full of broken limestone say 30 pounds over each charge, including the first.

Provide a slag hole about 2 inches in diameter either at the back or to one side of the cupola and about 15 inches above the sand bottom. For short heats it will not be necessary to open the slag hole but for long heats, from 2 to 10 hours duration, the hole may be left open from the first. From the fact that your tuyeres are set so high we take it that you are proposing to run long heats, otherwise the tuyeres could be set much nearer the sand bottom with a corresponding saving in the amount of coke required for the bed to fill the extra space.

Making a Pipe Pattern on the Band Saw

BY M. E. DUGGAN

SOMETIMES it is difficult to decide whether it is better to turn a pipe bend pattern in the lathe or pare and shape it by hand. If made in the lathe it is necessary to turn up a ring semicircular in section and radius corresponding to that of the desired bend. The only part of this ring that is used is a piece long enough to make the bend, the remainder generally is wasted. The advantage of this method lies in the direct and ready manner in which the desired form is obtained. A pattern that is shaped and pared by hand, no matter how skilfully it is done, is never as true as one turned in a lathe.

In thin, cored work, it is essential that pattern and corebox be shaped correctly and accurate. A slight deviation in either one will result in defective castings. On large work, such extreme accuracy seldom is necessary; but since the dividing line must be drawn somewhere a decision will be influenced largely by the tools, appliances and facilities at hand.

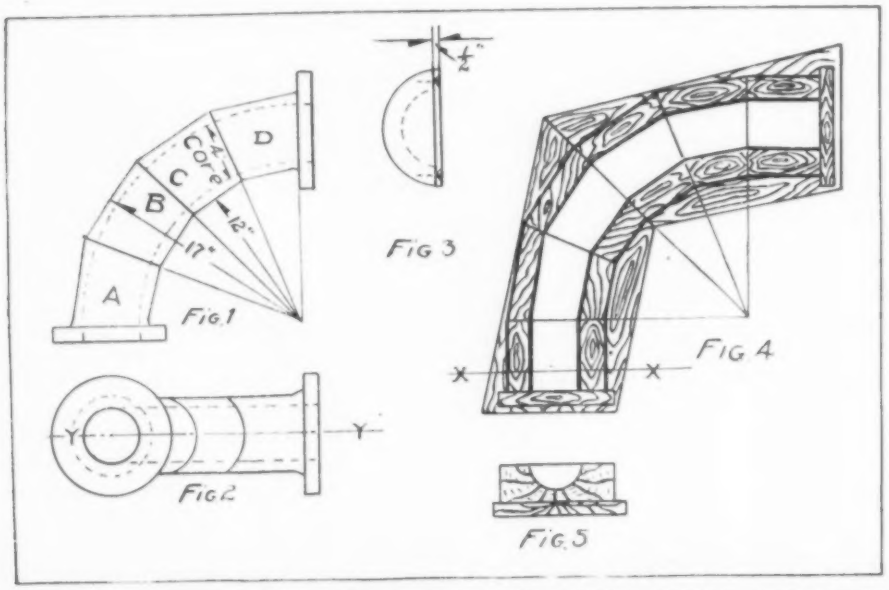
It is customary in some pattern shops to supply a skeleton or sweep corebox for pipe bends; but the majority of coremakers do not like to use this appliance and further, the results are not always satisfactory in the production of thin castings. A pipe bend pattern and corebox of unusual design are shown in the accompanying illustration. I have made a few patterns and coreboxes in this way and the castings have been quite satisfactory.

Both the pattern and corebox are made easily and quickly with a minimum of labor for the patternmaker. All the material entering into their construction is cut on the band saw. The pattern is split through the center and doweled in the regular way as indicated at *YY*, Fig. 2. The body, instead of forming the arc of a circle, is put together in straight section, *A, B, C, D*. These are cut to exact size on the band saw and then glued and fastened on a ½-inch board as shown in Fig. 3, which is an end view of the half pattern. The flanges and core prints are turned in the usual way and afterward the pattern is put together and finished with coarse sand paper.

The corebox is cut on the band saw and the sections are fastened together on a board as shown in Fig. 4. An end view in section through *X X* is shown in Fig. 5. From a superficial examination, it might seem apparent that this corebox would produce a core irregular in contour; but such is not the case. After the core is turned out on the drying plate it is gone over by the coremaker and all irregularities smoothed out until the surface presents an unbroken curved line.

The sections *A, B, C, D*, either may be turned in one long piece and afterward cut to the required length and angles, or they may be cut on the band saw right from the rough stock. Where extreme accuracy or other features do not call for a highly finished pattern, a rough and ready pattern is all that is required. This point frequently is overlooked as the following incident which came under the writer's observation will illustrate:

A water main embracing right angle and short radius fittings gave considerable trouble at these points. They were constantly clogging and required frequent cleaning. To overcome the trouble, it was decided to take out these fittings and replace them with long radius fittings wherever it was possible to do so. The new fittings were ordered from an out-of-town firm; but the superintendent, fearing that the fittings would not be delivered in time, ordered a pattern made in the company's own shop. The pattern and corebox were quite large and were shaped by hand. The patternmaker may not have been aware that these castings were to be buried out of sight under the ground. Perhaps he knew only one way—the long way—to do the job. Whatever the reason, the pattern and corebox, when finished, were classy pieces of work. Naturally, a job done in this way required both labor and time. In this particular case the out-of-town order was shipped and delivered on the ground before the home pattern was finished. A quickly made and rough pattern and casting would have been satisfactory.



PATTERN AND COREBOX FOR A PIPE BEND WHICH DEPART FROM THE CONVENTIONAL CURVED SHAPE

The Federal Supply Co., East 79th street, Cleveland, has been appointed representative in that territory for the Quigley Furnace Specialties Co., Inc., 26 Cortland Street, New York, manufacturers of refractory materials.

Chinese Employed Cement for Their Molds

The description of the ancient Chinese bronze war drum published in the Sept. 1 issue of THE FOUNDRY has aroused considerable interest and comment but so far there has been no further light thrown on the methods involved in the construction of the mold.

H. K Richardson, Middlebury, Conn., who spent 3½ years in Sze-Cheun province, China, states that he has at many times marvelled at the cast iron pots used for all purposes by the Chinese. Some of these pots measure 4 feet in diameter and are approximately 1 foot deep in the center. The metal in all cases is extremely thin, about ⅛ of an inch.

Mr. Richardson on one occasion visited a foundry where these pots were made and noted that they were cast in permanent molds made of cement. Both top and bottom of the mold were made of Chinese cement which is composed of a mixture of crushed or pulverized tile, clay and burned lime. This mixture is rammed quite hard and sets hard with a perfectly smooth surface.

Drawing Should Be Plain and Explicit

By M. E. Duggan

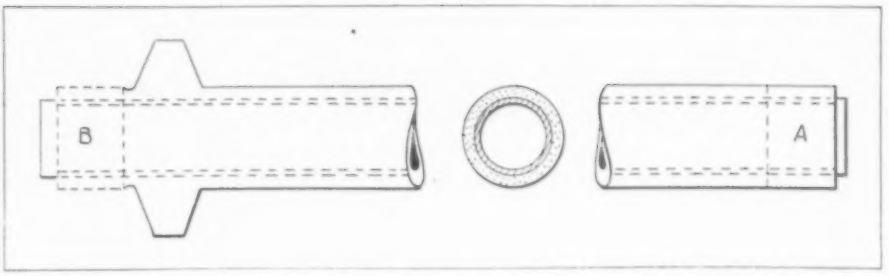
An incident involving the drafting room, the pattern shop and the machine shop came under my observation recently and as it is liable to happen at any time, particularly in a plant where the drawings and patterns are not checked over by a man detailed for that purpose, it is deserving of the attention of draftsmen in general.

In the construction of a special machine, four bronze journal box liners were required. Two of these liners were full circles while the other two were only half circles. The castings in both cases were identical, the only difference in their application being that in one case, two castings were used to make the circle and in the other case the half liner was used in the bearing by itself.

The order accompanying the blue print called for two patterns, one for each of the two styles of bearings. The reference number of the drawing was given and also the capital letters designating the parts specified. As if to make assurance doubly sure, two blue prints were furnished and since the pattern foreman received no instructions and there was nothing on the drawings to indicate that one pattern would do for both bushings, he naturally handed one of the prints to one of his men and the other print to a second.

When the mistake was discovered the patternmaker blamed the draftsman for making such an obvious mistake. The draftsman claimed that the patternmaker should have checked over both drawings before handing them to his men. It was learned afterward that the drawing was made for the machine shop.

All unnecessary detail should be omitted from drawings, especially those intended for use either in the pattern shop or foundry. They should be clear and carry sufficient supplementary information on them that they will be easily understood by the workman in whose hands they are placed. The same rule applies to the methods employed for marking patterns and coreboxes. A short note or a few words of instruction, will, in a great many instances, prove of the greatest value to the workman who is to work from a drawing.



A RING WAS CUT OFF THE GOOD END AT *A* AND SLIPPED ON THE BROKEN END *B*

An Emergency Core Repair Saved the Situation

By Thomas Nelson

We had an ornamental lamp standard, the last one of a long order, to pour on the day we received notice that the shop was to shut down for an indefinite period commencing on the following day. The wind was on before we were ready to place the core in the mold and then it was found that one end of the core was broken. Under ordinary circumstances it would have been patched and placed back in the oven to dry and the mold would have remained unpoured until the following day. In this instance it became necessary to devise some method of using the core as it was.

The core, shaped as indicated by the accompanying illustration, was made in loam run up on a barrel long enough to provide a 6-inch print at either end. The core was broken about 2 inches inside the core print at one end, but the other end was perfect. The barrel and core prints were the same diameter at each end so we cut a 4-inch ring off the good end and slipped it on the end that was broken. The joint was daubed with stiff oilsand and after the bearings had been built up a suitable height to engage the bare barrel instead of the sand core prints at each end the core was lowered into place. After closing the mold a little extra precaution was observed in securing the ends of the core and the casting was poured in a perfectly satisfactory manner.

Purchases Patent Rights

The United States Cast Iron Pipe & Foundry Co. announces that it has purchased from a Canadian syndicate headed by Gordon Perry, the exclusive rights to use the De Levaud patents in the manufacture of cast iron pipe by the centrifugal process in the United States and its possessions and in Cuba.

In Charge of Branch Office

L. W. Marso, in charge of the branch office of the Quigley Furnace Specialties Co., 427 Oliver building, Pittsburgh, has become associated with the Hardinge Co., 120 Broadway, New York, and will continue in the Pittsburgh office under the name of the Hardinge Co., but will specialize in the handling of pulverized fuel systems.

Firm Names Are Similar

Confusion has arisen connecting in the minds of some the name of the National Engineering Co., Chicago, manufacturers of foundry equipment, with the National Engineering Co., Irwin, Pa. These firms are in no way related to each other.

Moves Boston Office

The Boston office of the Cutler-Hammer Mfg. Co., Milwaukee, has been moved from the Columbian Life building, to Rooms 403 and 404 Harvey building, Chancy street. C. W. Yerger is manager of the office.

The Keller Pneumatic Tool Co., Grand Haven, Mich., has recently changed its corporate name to Wm. H. Keller, Inc.

THE FOUNDRY

Registered U. S. Patent Office

A semimonthly journal devoted to all branches of the foundry trade

Published by
THE PENTON PUBLISHING CO., CLEVELAND

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LONDON, ENGLAND.2-3 Caxton House, Westminster, S.W. 1
PARIS, FRANCE.....224 Rue de Rivoli
Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico.....$3.00 a year
Canada.....$4.00 a year
Great Britain and other Foreign Countries.....$5.00 a year
Single Copies.....25 cents
Copies published three months or more previous to date of current issue, 50 cents each.

ADVERTISING

All communications relating to advertising copy, discontinuances, etc., must be received on the 1st and 15th of the month preceding date of publication.

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Entered at the Post Office at Cleveland as Second Class Matter

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Foundry Presents Opportunities

USUALLY young men in the foundry industry do not take kindly to study, either during or after working hours. Whatever measure of ambition they possess is directed into channels probably possessing no bearing on the work upon which they depend, and will continue to depend for their daily bread. Of course, exceptions exist, and while a studious disposition does not guarantee that the owner one day will be a bright and shining light in the foundry field, his chances of becoming such a man are decidedly better than those of the young man whose mind is not on his work during the day and who shuts the foundry out of his mind the instant he sheds his overalls and puts his tools away at night.

Even the studious are apt to become discouraged if their efforts are not rewarded and recognized immediately. They seem to think that a place should be provided for them without delay at the head, or close to the head of the procession. Based upon the number of men employed and the number of plants in full-time operation, the foundry industry has reached the lowest point recorded for years. Indeed it is doubtful if worse conditions, comparatively, existed at any time. The panic of 1903 and the stagnation of business in 1913 were serious, but they only lasted a short time and reaction, when it set in, was short and swift. The reaction was so rapid that people promptly forgot that there ever had been a panic and plunged wildly into extravagance and expansion.

It may be claimed that no useful purpose is served by raking up memories of past performances with their attendant mistakes traceable directly or indirectly to poor judgment, lack of training or that standard scapegoat, bad luck, occasionally, the latter deserves all that is attributed in blame, but in many instances ill fortune is invoked by the incompetent and those who are not willing to assume responsibility of their own shortcomings. However, one point is suggested by a retrospective glance that is well worthy of consideration at any time, and that is the fact that a period of depression does not last forever. As surely as business has gone down in the past and arisen again, so in the present instance it will come up smiling and present opportunities for smart, ambitious, competent young men.

Many young men have taken special courses of study to fit them for more responsible positions and others have gone through the form of taking a course of study. There is a difference between studying and reading. The average school boy commits a lesson to memory like a parrot, but the minute the examination is over he forgets promptly the greater part of what he has learned. Racing through a course of instruction and securing a diploma does not mean anything unless the knowledge has been digested and assimilated in a manner that renders it available when the occasion arises.

The young man who studies his work all the time, who tries to find an easier or a quicker way to do not only his own, but every job in the shop, is developing ability that some day will be invaluable. With the inevitable revivifying and expansion of business which even now shows signs of returning animation, that day is not far distant.

Trade Outlook in the Foundry Industry

WITH practically no outstanding features upon which to base the assertion, but with numerous small increments of improvement, foundrymen in general feel that the tide has turned. Even those whose shops are operating at less than 20 per cent of normal affirm that business is in the making for them, contingent upon substantial betterment which they can note in contributing lines of manufacture. True to the precedent of the months just passed, the pickup is not confined to single groups of castings manufacturers nor to certain sections of the country, but permeates nearly every field.

Small Shops Favored

Significant of the period through which the industry is passing is the comparative activity noted in the various foundries. The larger institutions, requiring production work for economical operation, in many cases are practically idle. At times they accumulate a backlog of orders and run for a few days only to drop into idleness again. On the other hand, the smaller foundries, light jobbing shops in particular, are able in most cases to carry on work with greater uniformity. The latter in some instances are favored further by contracts which are sublet by the larger institutions. Farming out work, also, is practiced in an increasing degree by the large foundries which form departments of manufacturing plants. Foundries in the smaller towns are reported to be generally more active than those of the same character in the cities. Gray-iron jobbing castings are slightly more in demand than during the last few weeks of 1921, and bids are keenly competitive, when work of any class is offered.

Prices of Raw Material for Foundry Use

CORRECTED TO JAN. 26

Iron		Scrap	
No. 2 Foundry, Valley	$19.00 to 19.50	Heavy melting steel, valley	$14.00 to 14.25
No. 2 Southern, Birmingham	15.00 to 16.00	Heavy melting steel, Pitts.	14.50 to 15.00
No. 2 Foundry, Chicago	19.00 to 19.50	Heavy melting steel, Chicago	11.50 to 11.75
No. 2 Foundry, Philadelphia	20.85 to 21.55	Stove plate, Chicago	14.00 to 14.50
No. 2 Foundry, Buffalo	1950	No. 1 cast, Chicago	14.00 to 14.50
Basic, Valley	18.25	No. 1 cast, Philadelphia	16.50 to 17.50
Basic, Buffalo	19.00 to 20.00	No. 1 cast, Birmingham	16.00 to 17.00
Malleable, Chicago	19.00 to 19.50	No. 1 cast, Buffalo	16.00 to 17.00
Malleable, Buffalo	19.50	Car wheels, iron, Pittsburgh	14.50 to 15.00
Coke		Car wheels, iron, Chicago	14.50 to 15.00
Connellsville foundry, coke	$3.50 to 4.00	Railroad malleable, Chicago	12.50 to 13.00
Wise county foundry, coke	5.50 to 5.75	Agricultural mal., Chicago	12.50 to 13.00
		Railroad malleable, Buffalo	13.00 to 14.00

Prices Are Low

One of the most important contracts before the industry is the letting for the vehicular tunnel to connect the Island of Manhattan with Jersey City. As has been stated previously, the work will involve about 115,000 tons of cast iron tunnel segments. The contracts will be let Feb. 7 and foundries as far west as the Mississippi have evidenced interest. None of the large eastern foundries are bidding on the entire job, and the greatest tonnage sought is said to be for 5000 to 10,000 tons of the castings. Rumor among some of the prospective bidders is discouraging, as a price of about $50 a ton is predicted. Improvement in steel mill operation has brought an increasing demand for rolls. Stocks maintained by the mills and on the yards of the roll foundries have been notoriously low during the period just passed. In consequence, the present output is being drawn into service almost as fast as it is available. The prices on iron rolls average about $72 a ton. The influence of freight rates upon prevailing prices is recognized through the recent appearance of W. R. Bean, Eastern Malleable Iron Co., Naugatuck, Conn., before the interstate commerce commission as a representative of the American Foundrymen's association of which he is president. Mr. Bean presented a brief setting forth the effect of present freight rates upon the foundry industry. The pressure for rate reduction has reached a peak and probably will bring reductions soon.

Railroads Must Buy

Informed opinion holds almost without exception that the railroad purchases of commodities must increase steadily through the year. Inventories show that reserve stocks of equipment are depleted, and even under the curtailed freight movement, purchases are necessary. The newly threatened mine strike, expected by some to take place about April 1, is a factor for consideration. Practically no stocks of fuel have been accumulated and early indications point to a coal panic rush that will tax to the utmost the railway capacity in mine territory and will react upon other regions. Malleable shops making railway sundries are slowly gaining headway, and a slight improvement in car buying would be registered in the foundries within a short period. Approximately 2500 cars have been placed in the east recently, and an inquiry is extant for 10,000 narrow gage cars for the National Railways of Mexico. The automobile show season has developed a feeling of optimism, supported in a measure by car orders for spring shipment. Automotive foundries still are on only part time schedules, but a tendency is noted among manufacturers to order greater quantities of castings in new contracts which are coming out. The probable curtailment of demand from the rural districts is a source of concern to automobile and implement makers.

Nonferrous Strengthens

Conditions in the brass foundry industry approximate those in the ferrous branches. Plumbing goods shops are working practically full time, while the automobile, ornamental brass and machinery demand is slack. Prices for nonferrous metals based on New York quotations in *The Daily Metal Trade* of Jan. 26, follow: Casting copper, 13.00c; electrolytic copper, 13.50c to 13.62½c; Straits tin, 30.75c to 31.00c; antimony, 4.45c; aluminum, No. 12 alloy, producers' price, 19.00c to 19.20c and open market, 14.00c to 15.00c. Zinc is 4.60c to 4.62½c, E. St. Louis.

Comings and Goings of Foundrymen

EGBERT H. BALLARD, manager of the Everett works, General Electric Co., Everett, Mass., was elected president of the New England Foundrymen's association, at the annual meeting held in Boston Jan. 11. Mr. Ballard has had an exceptional career, having been 28 years in the continuous employment of the General Electric Co. from the time he entered as clerk, in the foundry, to the present, when, in addition to his work as manager of the Everett plant, he is in charge of steel foundry work at Lynn. Mr. Ballard left the General Electric Co. sixteen years ago to take a position as manager of the Massachusetts Steel Foundries, at Everett, but before he could actually start his new work, the plant which he was to supervise was taken over by the General Electric Co., thus making his employment with that company uninterrupted. Mr. Ballard is a student of foundry questions and during his career has contributed largely to the development of the industry, especially in steel foundry work.

T. W. Rogers has been appointed representative of Canada Foundries & Forgings, Ltd., Brockville, Ont., in Toronto and western Ontario.

F. J. McGrail, formerly connected with the Honolulu Iron Works, Honolulu, T. H., has been made foundry superintendent for the Axelson Machine Co., Los Angeles, Cal.

R. B. Perry, who for the past six years has been connected with the Allen Motor Co., Columbus, O., has resigned from his position as director of sales and service to join the Atlas Brass Foundry Co. of that city as general sales manager.

T. J. Dillon Jr., president of the Standard Steel Construction Co., Ltd., Welland, Ont., has been elected president and general manager of Abendroth Bros., Port Chester, N. Y., manufacturers of soil pipe and fittings, gas ranges and heaters.

Gilbert T. Mason has been made district sales manager for Alloys & Products, Inc., New York, with headquarters in Buffalo. Mr. Mason until recently was assistant manager of the Titanium Bronze Co., Niagara Falls, N. Y., and previous to that time was with Clum & Atkinson, Rochester, N. Y.

Albert L. Brown at one time foundry superintendent Star Drilling and Machine Co., Akron, O., and later efficiency superintendent Sumner Iron Works, Everett, Wash., and for the past 14 months connected with the National Art Bronze Co., St. Louis, now is vice president and general manager the United States Brass & Aluminum Co., St. Louis.

W. H. Graul and J. J. Hughes have resigned from the American Steel Foundries at Chicago and have opened offices at 1313 Peoples Gas Building

EGBERT H. BALLARD

where they will represent the Ohio Steel Foundry Co. and the McConway & Torley Co. The former is a manufacturer of steel castings at Lima, Springfield and Bucyrus, O., and the latter is a builder of car couplers at Pittsburgh.

New England Foundrymen Meet in Boston

The election of new officers for the year 1922 was the principal business before the twenty-sixth annual meeting of the New England Foundrymen's association, which was held Wednesday, Jan. 11, at the Exchange club, Boston. Nearly 200 members of the association were present. After the incoming officers had each made a brief speech of acceptance, the evening was turned over to the social committee. E. H. Ballard, in his presidential address as president, reviewed the history of the association during the quarter century of its existence, and outlined some of the plans for the coming year. The new officers and executive committee follow: President, E. H. Ballard, General Electric Co. Lynn, Mass., vice president, George A. Ray, Taylor-Fenn Co. Hartford, Conn., treasurer, George H. Gibby, Gibby Foundry Co. East Boston; secretary, Fred F. Stockwell, Barbour-Stockwell Co., Cambridge, Mass. The new executive committee is Charles A. Reed, Reed Fears & Miller, Boston; L. M. Sherwin, Brown & Sharpe Manufacturing Co., Providence, R. I., Harry T. Welch, Milford Iron Foundry Co., Milford, Mass., R. F. Harrington, Hunt-Spiller Manufacturing Co., South Boston, and Norman Russell, Albert Russell Sons Co., Newburyport, Mass.

Chicago Foundrymen's Club Chooses Officers

John E. Schindler of the Garden City Foundry Co. has been elected president of the Chicago Foundrymen's club for 1922, and George E. Carlin of the United Boiler & Foundry Co., Hammond, Ind., vice president. George H. Manlove of THE FOUNDRY was re-elected secretary-treasurer. Retiring directors were re-elected for the two-year term. At the January meeting the club entertained at a ladies night with dinner and vaudeville.

Stresses Tests as Cure for Casting Ills

"What the foundry foreman needs is help not hell; help to eliminate bad castings, not hell for producing defective ones in an effort to make production records," declared Herbert M. Ramp, superintendent of foundries of the American Locomotive Co., Dunkirk, N. Y., before the monthly meeting and dinner of the Pittsburgh Foundrymen's association, held at the General Forbes hotel, Pittsburgh, Monday evening, Jan. 16. The gathering was one of the most successful ever held by the organization, both from point of attendance, over 75 members being represented and from point of discussion, subsequent to the presentation of the paper. This was by past presidents of the American Foundrymen's association, Carleton S.

Koch, president of the Fort Pitt Steel Casting Co., McKeesport, Pa., and Benjamin D. Fuller, who recently was made a life member of the Pittsburgh organization.

Mr. Ramp stressed the importance of tests by chemists of sands, blackings, core binders, etc., to the end that castings shall be more uniform in character and defective tonnage accordingly reduced. He said: "Eliminate all possible cause of jealousy between the foundry foreman and the chemist. The latter should be the foreman's consulting engineer whenever trouble does arise. The chemist should be a real aid to the foundry foreman in increasing the shop's reputation for furnishing uniformly good castings. To bring this about, the chemist should test every car of sand, every shipment of blacking, every purchase of core binder. Keep materials that enter into casting production uniform and defective castings will be fewer."

He stated that while at present the average loss in foundries is 10 to 15 per cent, that still is too high and the only way to reduce it is by proper attention to chemical tests. He called attention to how difficult it ofttimes is to have an appropriation for foundry equipment and tools approved while it was comparatively easy to have any expenditure for machine tools O.K'd. He stated that proper equipment must be furnished the workmen, else neither quantity nor quality production can be expected.

To Manage Cleveland Office

Zeno D. Barns has been appointed Cleveland manager of the Ajax Metal Co., Philadelphia, succeeding Louis E. Purnell who died recently. The Clevelang office which is located at 429 Schofield building, will serve the states of Ohio and Michigan. Mr. Barns formerly was connected with the Westinghouse Electric & Mfg. Co. and the Westinghouse Air Brake Co.

Philadelphia Foundrymen Name Officers

Officers of the Philadelphia Foundrymen's association, with one exception, will be the same in 1922 as in 1921. At the association's meeting on Jan. 11, C. R. Spare, president of the American Manganese Bronze Co., Holmesburg Junction, Philadelphia, was elected vice president to succeed George C. Davies, Pilling & Co., Philadelphia. Officers re-elected are: President, Thomas Devlin, Thomas Devlin Mfg. Co., Philadelphia; treasurer, William G. Summers, Phoenix Iron Co., Phoenixville, Pa., secretary, Howard Evans, J. W. Paxson Co, Philadelphia. The executive committee again consists of Walter Wood, R. D. Wood Co., Philadelphia; Frank Krug, White & Bro., Inc., Philadelphia, Frank Hodson, Electric Furnace Construction Co., Philadelphia; Walter T. MacDonald, Fletcher Works, Inc., Philadelphia; W. T. Dunning, Chester Steel Castings Co., Chester, Pa., and J. Howard Sheeler, Sheeler-Hemsher Co., Philadelphia.

Fix Date and Place for A. F. A. Convention

FINAL arrangements have been made for holding the annual convention and exhibit of the American Foundrymen's association and allied societies in Rochester, N. Y., during the week of June 5, 1922, instead of in Cleveland in April. The change of place and date was made imperative by uncertainty regarding the completion of the Cleveland public hall. The convention bureau of the Rochester Chamber of Commerce previously had extended a warm invitation to hold the 1922 convention in that city and this invitation was promptly renewed when uncertainty clouded the Cleveland plans.

The technical meetings and the exhibition will be housed at Exposition park, Rochester's million dollar convention center. The arrangement of buildings, affording accommodations for all classes of exhibits and comfortable, commodious assembly rooms for the group and general sessions incident to the convention, offer ideal surroundings for a record gathering. Hotel accommodations ample to care for an attendance equal to that of the Columbus convention have been guaranteed.

Brass Foundrymen of New York Hold Election

At a recent meeting of the Metropolitan Brass Founders' association held at the Building Trades club, New York, the following officers were elected:

President, F. H. Landolt, Penn Brass & Bronze, Brooklyn; vice president, W. D. Goldsmith, C. A. Goldsmith Co., Newark; secretary and treasurer, W. E. Paulson, Thos. Paulson & Son, Brooklyn.

The new members of the executive committee which were elected at this meeting are:

Thomas Harper, Thomas Harper, New York; Joseph Bechtold, New York Brass Foundry, New York; and Thomas Williams, E. A. Williams & Son, Jersey City.

Census by Safety Council

The national safety council, with headquarters at 168 North Michigan avenue, Chicago, is conducting a census of all persons throughout the country interested in or responsible for safety work in industrial plants, public utilities, municipalities, and other organizations. Such a census, the safety council believes, will enable it to quickly find speakers, writers and workers through whom efforts toward accident prevention may be extended.

Obituary

James A. Brady, aged 74 years, died Jan. 7 at his home in Chicago. He was a pioneer foundryman and was an organizer and president of the James A. Brady Foundry Co., Chicago. He retired from that interest about 25 years ago and since that time had operated a small foundry in Chicago and one at Waterloo, Iowa. He had been retired from active business for some time.

William Hathaway Coffin, for the past 20 years representative of the Springfield Facing Co., Springfield, Mass., died recently at his home, 112 Magnolia St., Roxbury, Mass. at the age of 73 years. He was well known among foundrymen.

School Offers Research Fellowship

To assist in the conduct of engineering research and to extend and strengthen the field of its graduate work in engineering, the University of Illinois, Urbana, Ill., maintains fourteen research graduate assistantships in the engineering experiment station. Two other such assistantships have been established under the patronage of the Illinois Gas association. These assistantships are open to graduates of approved American and foreign universities and technical schools who are prepared to undertake graduate study in engineering, physics, or applied chemistry. Dean C. R. Richards will accept applications for these assistantships up to March 1, 1922.

F. A. Coleman, who has been engaged in the design and manufacture of foundry equipment for the past 17 years recently resigned his position as vice president and general manager of the Foundry Equipment Co., Cleveland, O. Mr. Coleman now is located at 1951 E. 57th St., Cleveland, O.

Indicates Temperature of Molten Metal

A pyrometer, for indicating the pouring temperatures of nonferrous metals recently has been developed by the Taylor Instrument Companies, Rochester, N. Y. The pyrometer outfit, which is especially desired for measuring the temperatures of molten metals, consists of three parts: the thermocouple, the indicator, or meter, and the flexible connecting cable.

The thermocouple is designed and built to withstand the severe service encountered in foundry use. It is made of steel tubing forming an angle at the lower end, which allows the operator to stand at the side of the crucible.

The binding posts, for attaching the connecting cable, are located on the under side of the top fitting; thus allowing the thermocouple to be placed in an upright position on its end, when not in use, without danger of breaking or wearing the flexible conductor at this point. The handle is located so that the thermocouple may be held with the upper fitting under the operator's elbow, as shown in the accompanying illustration. The lower fitting and connection terminals are of substantial construction, and thoroughly insulated by a special, heat-resisting, insulating material.

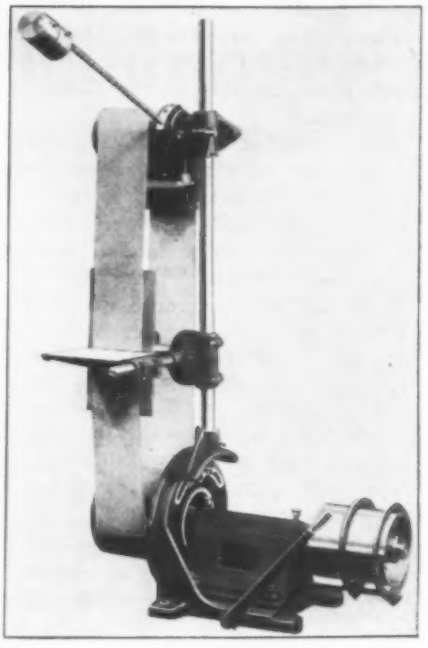
The replaceable tip, or junction, of the thermocouple itself consists of ¼-inch diameter nickel-chromium elements, and is securely fastened into the terminals by heavy set screws. The positive terminal is drilled deeper than the negative, the length of the elements of the junction corresponding. This renders it impossible to reverse the polarity of the couple when inserting a new junction, thereby causing an erroneous indication, which is an important factor to consider where unskilled labor is employed.

No sheath, or other means of protection is placed over the tip of the thermocouple as this would seriously affect the sensitiveness of the instrument and introduce a lag in readings which is detrimental to successful results. The bare thermocouple will indicate almost instantaneously upon insertion in the crucible. The elements making up the replaceable junction are of large cross section, which insures their rendering a satisfactory period of use before replacement is necessary due to the corrosive action of certain metals, particularly brass and bronze. With aluminum, this action is not serious, and the period of use of the thermocouple is many times that obtained in copper alloys.

WITH A BARE TIP IMMERSED IN MOLTEN METAL A QUICK TEMPERATURE READING IS SECURED

The indicator, or meter, supplied as a part of the outfit, is a standard portable-type instrument. It consists of a sensitive yet rugged movement contained in a compact, strong aluminum case. It is provided with a long, open, easy-reading scale, ranging from 0 to 2400 degrees Fahr. An easily accessible zero adjustment is provided. The indicator does not require leveling in use, and readily can be transported without likelihood of injury.

In service, it may be held in the manner shown in the accompanying illustration, or may be located on a convenient stand or holder where the position of crucibles, metal pots, etc., warrants. A 10-foot length of reinforced flexible rubber-covered conductor, fitted with solderless terminals containing a side slot, is supplied for connecting the thermocouple to the meter.



BELT SANDER WILL HANDLE PLAIN AND FLAT SURFACES

Designs a New Belt Sander

For use in rapid sanding and polishing of small irregular shapes, edge work and flat surfaces, the Oliver Machinery Co., Grand Rapids, Mich., recently brought out a newly designed belt sander. This machine, it is claimed will do the work of a disk sander as well as a drum sander.

In principle the machine involves a main drive pulley mounted on a countershaft and the entire frame swings about the center line of the countershaft on an axis. On this supporting arm two clamp brackets for supporting the main idler pulley and the ten-

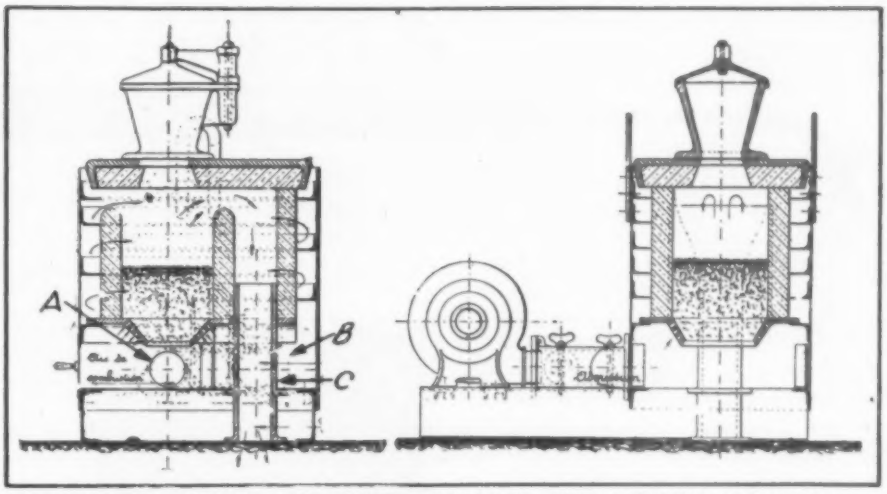
sion idler, are carried. Another support arm carries the table and backing plate, or for special work special or flexible pads. The machine, which is shown in the accompanying illustration, has a capacity to take belts up to 10 inches in width and 14 feet in length. The edging table tilts and a backing plate is furnished for the attachment of forms. Ball bearings are used and the unit may be arranged for direct motor connection.

Portable Device Used to Dry Molds

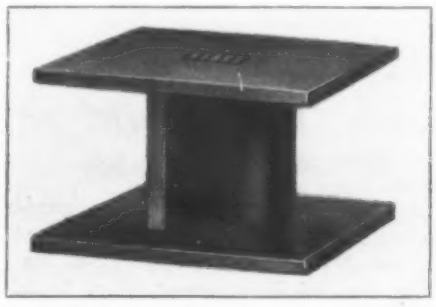
The portable mold drying apparatus shown in longitudinal and cross section in the accompanying illustration is a European development patented by George Piron, 19 Avenue du Boulevard, Brussels, Belgium. It has been designed primarily for drying molds made in the floor or in large flasks beyond the crane or oven capacity. By a slight variation in construction, the device may be adapted for use in stationary oven installations. It is claimed that with a blower and special type of grate it will consume the cheapest kind of fuel and deliver air at the outlet at 450 degrees Cent., or 842 degrees Fahr.

The entire apparatus weighing about 1200 pounds is enclosed in a sheet-steel frame mounted on channels and provided at the top with a pair of loops by which it may be lifted from one place to another. A ½-horsepower motor direct-connected to a fan delivering 350 cubic feet of air per minute at a pressure of 5 inches of water, is mounted on the frame supporting the firing chamber.

The *Y*-pipe leading from the fan to the firing chamber is provided with three dampers or gates, one in the main pipe and one in each of the branches and by these the speed of combustion may be regulated while the motor runs at a constant speed. One branch discharges air directly under the grate while the second discharges into a chamber surrounding the fire pot and furnishes oxygen to consume the coal dust which otherwise would be drawn into the conduit leading to the mold being dried.



AIR FROM THE FAN IS DELIVERED THROUGH THE OPENINGS SHOWN AT *A* AND *B* AND EVENTUALLY, AS INDICATED BY THE ARROWS, IS DISCHARGED AT A TEMPERATURE OF 842 DEGREES FAHR., THROUGH THE PIPE *C* INTO THE MOLD



THE PECULIAR SHAPE OF THE STEM FURNISHES AMPLE SUPPORT TO THE HEADS

New Chaplet with a Stem

The chaplet shown in the accompanying illustration and on which a patent is pending, recently has been developed and placed on the market by Smith & Richardson Mfg. Co., Geneva, Ill. The stem is made from flat metal bent to the shape of a letter *S*. This design furnishes support for the head and at the same time presents a large surface to the molten metal so that the chaplet fuses readily into the casting. The heads are fitted and riveted to tenons cut on the stem and rest against shoulders which provide a bearing surface. Square heads of a size proportionate to the stem are furnished regularly, but special heads straight or curved any desired size or thickness also may be secured. It is claimed that the peculiar shape of the stem does not obstruct the flow of metal and eliminates danger of gas pockets. They are furnished plain or tinned.

Rammer May Be Attached to Shovel Handle

The adjustable rammer shown in the accompanying illustration has been devised by Harry E. Wolf, Hastings, Mich., to replace the ordinary double end rammer having a peen at one end and a butt at the other. It may be attached to any suitable length of wooden handle. The adjustable tamping head mounted between a pair of forked arms may be latched either in a horizontal or vertical position relative to the handle.

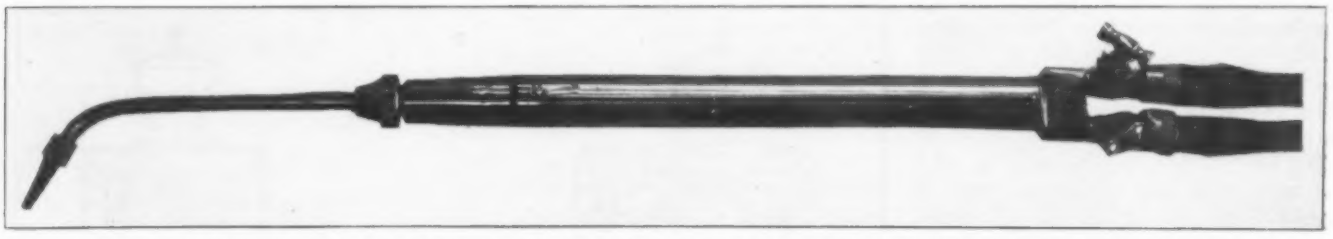


FIG. 1—WELDING TORCH WITH WELDING TIP AND A SHORT EXTENSION TUBE ASSEMBLED FOR USE

Designs Portable Torch

For convenience in carrying a welding torch and necessary auxiliary equipment from place to place, the Davis-Bournonville Co., Jersey City, N. J., has manufactured a compact outfit which can be packed into a convenient carrying case. One of these cases with the equipment packed inside is shown in Fig. 2. With the apparatus any welding job may be accomplished regardless of size or conditions. Included in the outfit are the welding torch, three extension tubes, five welding tips, a decarbonizing tube, an oxygen regulator, an acetylene regulator, hose, a sparklighter, colored glasses and the necessary wrenches.

The mixing chamber, which is arranged in the head of the torch, is so constructed that the gases are mixed properly before entering the tips. Both the extension tubes and tips, which are provided in several sizes, are made of copper. For assistance to the operator, pressures of acetylene for use with the various sizes of tips are stamped on the handle of the machine.

FIG. 2—CARRYING CASE SHOWING HOW TORCH AND AUXILIARY EQUIPMENT IS PACKED WITHIN

Makes Improvement on Portable Elevator

A number of improvements made on a portable elevator manufactured by the New Jersey Foundry & Machine Co., 90 West street, New York, has increased the field of application for this machine. This device, as shown in the accompanying illustrations Figs. 1 and 2, consists of two platforms and hoisting devices by which means boxes and barrels may be raised from the floor on one platform and rolled or pushed off onto the other platform which is adjusted to the proper height for piling or tiering. Formerly the machines were furnished with either a flat or a roller platform while now they are manufactured with removable, reversible flat and roller platforms which can be reversed on the machine without removing or replacing bolts. Another improvement has been made in the lever arrangement for raising and lowering the top section, the lever being secured by springing it into a clip fastened to one of the elevator guides. To raise and lower the top with this arrangement, the operator manipulates the lever which is within easy reaching distance, thus adding to the safety of workmen. Only one man is required to operate the machine which is light but strong. Among the advantages claimed for this elevator are the saving of labor, increasing of storage space, decreasing the breakage of goods, together with greater safety for the operator.

A suitable and secure platform is provided for the workmen by means of a stabilizing device which gives four points of support. Two of the legs rest on the floor while the machine is in operation. The hoisting device is a system of spur gearing so arranged that heavy loads may be lifted at low speed while lighter loads may be handled at greater speed. The brake is of the friction disk type and holds the load at any point automatically. Either hand power or electric drive may be supplied. Fig. 1 shows the operator adjusting the top section by means of the lever while Fig. 2 shows a barrel being unloaded after it has been raised from the floor.

FIG. 1—RAISING AND LOWERING THE TOP SECTION BY MEANS OF THE LEVER

FIG. 2—UNLOADING A BARREL WHICH HAS BEEN RAISED FROM THE FLOOR LEVEL

Slight Pickup in Equipment Sales

Better Foundry Operation Not Entirely Reflected in Purchases of Machinery and Supplies—Eastern Market More Active—Tunnel Letting Arouses Interest

FEW signs of improvement are visible in the foundry equipment market, although some pickup in foundry operation is taken to presage betterment. New projects are rare, but replacement and repair inquiry is expected to develop in strength as the year advances. Eastern interest in equipment excells that noted in the central states, in line with the greater foundry activity in the former localities. The Welsbach Co., Gloucester, N. J. has purchased a high frequency induction furnace from the Ajax Electrothermic Corp., Trenton, N. J. Three furnaces have been purchased from the same company by the U. S. Molybdenum Metals, Ltd., Los Angeles, Cal. The Lima Brass & Iron Foundry, Lima, O. is at present equipping a malleable foundry to produce 30 tons per day. The Houghton Malleable Castings Co., 966 Spitzer Bldg., Toledo, O. expects to start construction of a new plant in the early spring. Ralph H. Staples Mfg. Co., Mt. Vernon, Ind. will install a small machine shop.

Inquiries Improve In The East

INQUIRIES are coming out in greater volume in the East. Many of these, sellers assert, will not materialize in the near future, as they appear to be largely for the purpose of sounding out prices and in keeping track of newly developed equipment. On the other hand, other inquiries appear to be bona fide. This latter is for equipment for replacement purposes, and appears to be principally from New England. One large New England foundry has recently set aside a sum for the expenditure of $5000 monthly on foundry equipment over the next several months. One project likely to get under way in the near future is the plant of the Duroth Steel Truck & Car Wheel Co., Granite City, Pa. Plans have been completed, and the construction, it is said, will be started as soon as weather conditions become more favorable. The Standard Sanitary Co., Pittsburgh, which recently took over the Goodyear plant at Long Island City, N. Y., is likely to be in the market in the near future for some foundry equipment. As time draws near for the opening of bids on the cast-iron segments for the Manhattan-New Jersey vehicular tunnel on Feb. 7, interest among foundry equipment sellers is becoming more intense. While it is conceded that this work will be allotted to a relatively few foundries, it will, nevertheless, be reflected in greater activities at other foundries, as considerable jobbing capacity will be taken out of the market. It is believed that inquiry for new equipment will be stimulated. Incidentally, in connection with the vehicular tunnel project, several foundries, which recently figured upon bidding for work have withdrawn. Export demand, while greatly restricted, continues to result in an occasional order. A recent order calls for a ½-ton electric furnace for the Compania Nacional de Electridad, Barcelona, Spain, the business going to the Pittsburgh Electric Furnace Corp., Pittsburgh.

Slackened Interest In Pittsburgh District

FOUNDRY equipment sellers in the Pittsburgh district report a continuance of the same general condition existent since the first of the year and in some cases since before that time. Sales of foundry machinery are at a low ebb due to the curtailed rate of operation among foundries. In many cases operations have not resumed after the holiday shut-downs while in others, foundry departments are not operated at above 15 or 20 per cent of capacity. Several companies are in the market for cupolas, core ovens, etc., but inquiries hanging fire for over two months still are held in abeyance due to a disinclination to make unnecessary expenditures. The same condition governs the electric furnace industry where the tendency to hold off on cash outlays likewise is marked. However, the Oil Well supply Co., Oil City, Pa., is scheduled to purchase an electric furnace with auxiliary equipment at an early date. Present sales of foundry equipment seem to be confined to small supplies as needed. Included are a number of flasks, inquiry on which has increased slightly, and prices are being asked upon a few small ladles, etc. If foundries in this district are able to gather in a portion of the orders for castings involved in the New York vehicular tunnel job to be let Feb. 7 it will in all probability stimulate the foundry equipment trade somewhat. One interesting inquiry now before the trade involves an 8-foot sand mixer from a nearby user.

Chicago Equipment Dull

SLIGHTLY improved conditions in foundry equipment demand continue to be noted in the Chicago district, following a slight increase in melt, although many signs in the railway and automotive fields indicate early betterment. Cupolas, ladles, molding machines and general supplies sold during the past fortnight have been largely for eastern delivery.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

The foundry at the plant of the Studebaker Corp., South Bend, Ind., recently was damaged by fire.

The foundry owned by McLean, Holt & Co., Fredericton, N. B., recently was damaged by fire.

Contract has been awarded by the Wheeling Mold & Foundry Co., Wheeling, W. Va., for the erection of a shop building, to be 1-story, 60 x 287 feet.

A permit has been granted to the Filer & Stowell Co., Milwaukee, manufacturer of engines,

sawmill machinery, etc., to build a cupola house, 40 x 50 feet, at Becher street and Robinson avenue, Milwaukee.

The Paragon Foundries, Oregon, Ill., is erecting an addition to its plant.

Improvements to its plant at Huntington, W. Va., are reported being considered by the American Car & Foundry Co.

Edwin Miller, 1199 Main street, Buffalo, has purchased a building which he plans to remodel for the manufacture of mining machinery, etc.

The Interstate Car Co., Massachusetts avenue and Sherman drive, Indianapolis, is reported planning the erection of a foundry to be built at an estimated cost of $25,000.

The Economy Tractor Co., Greenville, S. C., recently was incorporated with a capital stock of $100,000, by W. C. Cleveland, J. P. Hughes, and others.

The American Car & Foundry Co., Terre Haute, Ind., recently awarded a contract for the erection of a building to be 1-story, 50 x 70 feet, to be built at an estimated cost of $25,000.

Part of the plant of the Boll Bros. Mfg. Co., Fourteenth and Howard streets, Harrisburg, Pa., manufacturer of brass and other metal beds, recently was damaged by fire.

The Kankakee Foundry Co., Dayton, O., recently was incorporated under the laws of Ohio, by John G. Haswell, H. D. Hunter, G. E. Swank, O. V. Coon, and a number of others.

Permit has been issued to the Sterling Brass Co., 4612 St. Clair avenue, Cleveland, to erect a foundry building at 9600 Catherine avenue, Cleveland.

The Reliance Foundry Co., Richmond, Ind., is having plans drawn for the erection of a foundry building, which will be 1-story, 85 x 110 feet, and be built at an estimated cost of $30,000.

The Lima Brass & Iron Foundry Co., Lima, O., is reported considering a proposition to move its plant to St. Marys, O., on an offer of 3 tons of casting work daily by the St. Marys Wheel & Spoke Co.

Plans are reported being prepared by the Pacific Sanitary Mfg. Co., Fifth and Hensley streets, Richmond, Cal., for the erection of an addition to its plant which will be built at an estimated cost of $60,000.

Plans are reported being prepared by the Warren Foundry & Machine Co., Phillipsburg, N. J., for the erection of a plant building to be 2-stories, 60 x 100 feet. The company's offices are at 183 Sitgreaves street, Phillipsburg.

The old plant of the Davis-Price Foundry Machine Co., New Cumberland, W. Va., which recently changed hands, will be operated under the name of the Resistant Alloy Steel Castings Co. H. S. Ginger is superintendent of the plant, which started operations about Jan. 15.

Incorporation of the Lynn Foundry, Inc., Lynn, Mass., recently was effected under the laws of Massachusetts. The company which has a capital stock of $20,000 was chartered by I. George Pelletier, Mark A. Morin and Wilfred Russell, all of Salem, Mass.

Capitalized at $50,000 the Murphy Valve Co., Columbus, O., recently was chartered under the laws of Ohio with a capital stock of $50,000. Incorporators of the company are Harry G. Wakefield, William C. Jones, Dan R. Murphy, Henry Kelso Jr., and Frank C. Harrison.

The Lake Erie Foundry Co., Painesville, O., organized by Cleveland promoters over a year ago, and which began operations in the plant on Richmond street, Painesville, will resume operations shortly and will effect a reorganization. The plant will produce semisteel castings.

The American Foundry & Mfg. Co., Kansas City, Mo., care of H. H. Akers, Kansas City Life building, Kansas City, is having plans drawn for the erection of a stove works, the first unit of which will be 1-story, 90 x 140 feet, and which will be built at an estimated cost of $30,000.

The Warren Steam Pump Co., Warren, Mass., at its annual meeting held Jan. 19, elected the following officers: President, H. K. Hallett; treasurer, William W. Shuttleworth; clerk, Howard F. Phinney; auditor, Charles E. Anderson. The first three named were also elected directors.

The Hamilton Copper & Brass Works, Hamilton, O., recently was incorporated under the laws of Ohio with a capital stock of $50,000. Incorporators of the company are Minnie Duemer, Carl I. Duemer, Robert W. Mence, E. M. Kimbrough and Edgar A. Belden. Plans of the company have not been announced.

Capitalized at $15,000, the Lake City Foundry Co., 1919 North Kimball avenue, Chicago, recently was incorporated under the laws of Illinois, by Herbert W. Bye, 4100 South Ashland avenue, Chicago, Karl Lundquist, Henry E. Kretz, Edward Nelson, Thomas Jorgensen and Myrtle M. Kretz.

The Mohawk Mfg. Co., Waterbury, Conn., manufacturer of brass goods, plans to remove to Middletown, Conn., about April 1, having recently purchased the William E. Stroud property in that city. In addition the company is reported having plans prepared for the erection of a factory building, to be 1-story, 50 x 100 feet, which will be erected adjoining the present structure.

The William Powell Co., Cincinnati, manufacturer of valves, etc., recently purchased the former plant of the Cincinnati Grinder Co., on Colerain avenue, Cincinnati, and plans to make alterations to permit the manufacture of iron valves. The present plant of the company will be devoted exclusively to the manufacture of brass valves and fittings. The acquired property contains 36,000 square feet of floor space. In addition to the building, the purchase includes a number of cranes with which it is equipped. It is understood the company eventually will erect a foundry for making its own castings.

The Diebold Safe & Lock Co. at its annual stockholders' meeting recently elected the following directors: C. C. Upham, J. C. Welty, Ralph Rex, E. G. Bockius, J. L. Criswell, A. N. Scott and A. J. Roos. The secretary reported the year was the biggest in the company's history for vault work and other products. Mr. Upham, former vice president, who has for many years been in close touch with the company's business as a member of the executive committee and who represents the largest interests, assumes active management of the company as chairman of the board of directors. Other officers elected were J. C. Welty, president; J. L. Criswell and A. N. Scott, vice presidents, and A. J. Roos, secretary and treasurer.

Merging of the American Block & Mfg. Co. and the General Malleable Co., both of Warren, O., under the Warren Tool & Forge Co., will make little change in the operation of the several plants except as to management by the Tool & Forge company. The Malleable company's plant will be operated as the malleable division of the Warren Tool & Forge Co. It has a capacity of 600 tons of malleable castings per month. The Block & Mfg. Co. manufactures malleable unions with bronze seats and has a capacity of 250,000 unions a month. Officers of the company, which is capitalized at $1,800,000, are: President, James D. Robertson; vice president, M. J. Konold; treasurer and general manager, George F. Konold, and secretary, George F. Konold Jr.

New Trade Publications

HEAT TREATING FURNACES—The W. S. Rockwell Co., New York, has published an 8-page illustrated booklet in which stationary and continuous furnaces for the heat treatment of springs, are described and illustrated.

METAL POLISHING—The Norton Co., Worcester, Mass., is circulating a 28-page illustrated booklet in which metal polishing is described. The booklet goes into detail as to the materials to be used in this work, and the various kinds of operations to which the different materials are best adapted.

FIRE BRICK—The Union Mining Co., Baltimore, is circulating a leather-bound, 150-page, illustrated booklet in which fire brick are described and illustrated. The booklet not only contains a description of the company's various kinds of brick, but includes general information on the subject of fire brick which has been taken from authoritative sources.

ELECTRIC FURNACES—The Repel-Arc Furnace Co., Indianapolis, is circulating a 4-page illustrated folder in which electric arc furnaces are described. The booklet briefly discusses the fundamentals which should receive attention in the purchasing of an electric furnace. The information given should be of value to those interested in electric furnace equipment.

GENERATORS—The Ideal Electric & Mfg. Co., Mansfield, O., has published an 8-page illustrated booklet in which generators for electroplating apparatus are described and illustrated. These machines embrace a broad range in ampere capacity, according to the booklet, and operate at 6 or 12 volts. They are used for electroplating, galvanizing, extraction of metals, electrotyping, and for all similar electrolytic processes.

FOUNDRY MIXER—The National Engineering Co., Chicago, has published a 12-page illustrated booklet in which foundry mixers are described and illustrated. It is stated these mixers are economical and efficient for all kinds of sand mixtures in foundries producing steel, gray iron, malleable, brass and aluminum castings, as well as for mixing daubing to line cupolas, ovens, ladles, furnaces, etc., and for blending other materials requiring intensive mixing action. The mixers are described in detail.

GRINDING WHEELS—The Norton Co., Worcester, Mass., has published a booklet in which factors affecting grinding wheel selection are given. According to the booklet, grinding plays such an important part in modern manufacturing processes that an understanding of the factors involved in selecting a grinding wheel for a certain job is extremely helpful to the shop superintendent, methods engineer, foreman and workmen. The booklet points out just what factors have to be considered and the relative importance of each. The data are valuable and interesting.

UNIVERSAL BLOWER—The Syracuse Industrial Gas Co., Syracuse, N. Y., is circulating a 4-page bulletin in which a universal blower is described and illustrated. The characteristics and advantages of this machine as asserted in the leaflet, include: Low power cost, no wearing contacts, has compactness of direct connected unit with none of the disadvantages; retains its efficiency indefinitely; standard motors may be purchased independently and replaced quickly; can be located upon side wall or ceiling without change; is quiet in operation; requires small space; no internal lubrication needed; is equipped with high grade ball bearings and current consumption decreases with lower demand for air. According to the leaflet this blower is particularly applicable for use in connection with oil or gas burning furnaces.